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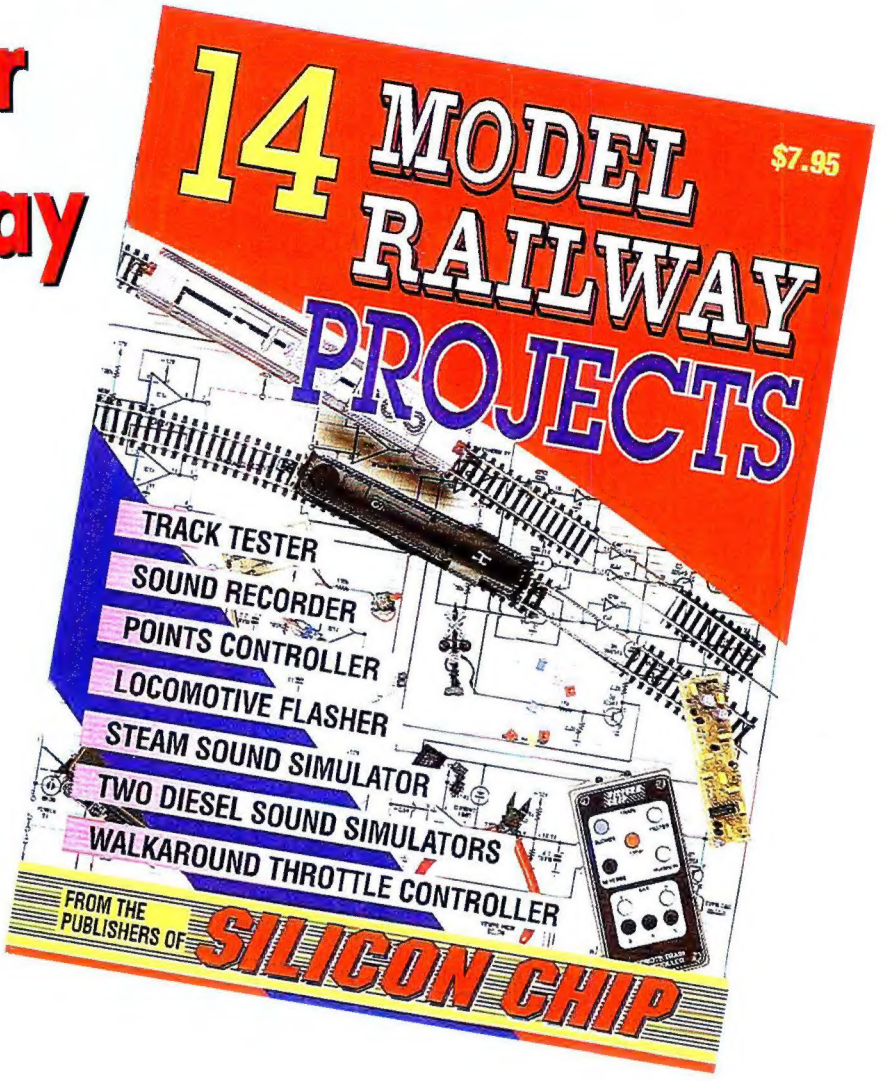

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VOL.9, NO.1; JANUARY 1996

Contents

THE DO'S AND DON'TS OF LIVING WITH ENGINE-MANAGED CARS – PAGE 4

FEATURES

4 LIVING WITH ENGINE-MANAGED CARS

We take a look at some of the do's and don'ts when it comes to maintaining a modern engine-managed car. Also, is it worthwhile changing the chip or are there better ways of increasing engine performance? – by Julian Edgar

10 RECHARGING NICAD BATTERIES FOR LONG LIFE

Nickel cadmium and nickel metal hydride batteries often don't last very long before requiring replacement. One solution is to use "burp charging" which is claimed to greatly extend battery life – by Horst Reuter

53 SATELLITE WATCH

A new column that gives you satellite reception reports for Australia and New Zealand – by Garry Cratt

PROJECTS TO BUILD

22 SURROUND SOUND MIXER & DECODER

Build this unit and add depth and realism to your home videos. It provides realistic surround sound mixing and even includes a simple decoder – by John Clarke

40 BUILD A MAGNETIC CARD READER & DISPLAY

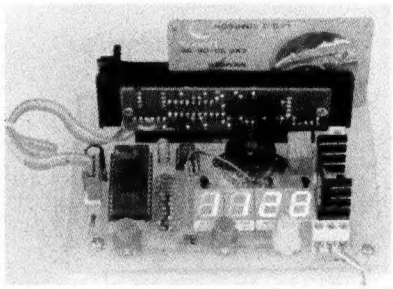
Check out what's written on the magnetic stripe on your credit card. This unit could also be used as the basis for an electronic door lock, restricting access to those with "authorised" cards – by Mike Zenere

54 THE RAIN BRAIN AUTOMATIC SPRINKLER CONTROLLER

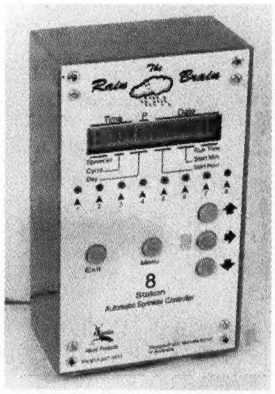
Comes as a kit and controls up to eight solenoids plus a master solenoid. You program it yourself to selectively water any area of your garden as little or as often as you like – by Graham Blowes

70 IR REMOTE CONTROL FOR THE RAILPOWER MK.2

Provides complete freedom of operation and has pushbutton control for everything. An optional speed meter is also included – by Rick Walters



BUILD A MAGNETIC CARD READER & DISPLAY – PAGE 40



8-STATION SPRINKLER CONTROLLER – PAGE 54

SPECIAL COLUMNS

32 COMPUTER BITS

Upgrading your PC; is it worthwhile? – by Geoff Cohen

80 SERVICEMAN'S LOG

The complaint seemed simple enough – by the TV Serviceman

86 VINTAGE RADIO

Converting from anode bend to diode detection – by John Hill

DEPARTMENTS

2 PUBLISHER'S LETTER
3 MAILBAG
16 CIRCUIT NOTEBOOK
63 PRODUCT SHOWCASE
69 ORDER FORM
92 ASK SILICON CHIP
94 NOTES & ERRATA
95 MARKET CENTRE
96 ADVERTISING INDEX

IR REMOTE CONTROL FOR THE RAILPOWER MK.2 – PAGE 70

Publisher & Editor-in-Chief
Leo Simpson, B.Bus.

Editor
Greg Swain, B.Sc.(Hons.)

Technical Staff
John Clarke, B.E.(Elec.)
Robert Flynn
Rick Walters

Reader Services
Ann Jenkinson

Advertising Enquiries
Leo Simpson
Phone (02) 9979 5644

Regular Contributors
Brendan Akhurst
Garry Cratt, VK2YBX
Marque Crozman, VK2ZLZ
Julian Edgar, Dip.T.(Sec.), B.Ed
John Hill
Jim Lawler, MTETIA
Philip Watson, MIREE, VK2ZPW
Jim Yalden, VK2YGY
Bob Young

Photography
Stuart Bryce

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PUBLISHER'S LETTER

Crystal balling the telephone

With the advent of the new year and the new century being not far away, it is timely to think about products that could appear in the near future. After all, with people being so conscious of computers, cellular phones, video and pay TV, the Internet and so on, it is common topic of conversation: "what will be next big consumer product?" No-one really predicted that cellular phones would be as popular as they have become and it is my opinion that another telephone derived product will be the next big seller.

An obvious derivative, to my mind, is a small computer combined with a fax machine. Perhaps it would be called a "fax terminal" or something similar. This would have a typewriter keyboard and LCD screen and probably not much storage but you could type a message on the screen and then send it to another person's fax machine. It could also receive fax messages but would not normally print them out, unless you wanted it to. Perhaps it would send a short voice message as well. You could also use it to pay bills and do all the things that a fax machine can do now. Such a machine is feasible now. It could be in many homes within five years.

Another more expensive product would be a home telephone exchange and burglar alarm system. Most small businesses have a phone system now, with three or four incoming lines and up to eight extensions. They can transfer calls, allow conferencing and operate as an intercom. Currently priced at around $2000 to $4000, such systems are becoming cheaper all the time. Five years ago, equivalent systems were priced at around $8000 or more and are now just starting to be installed in larger homes where their convenience is really appreciated – no more shouting to call people to the phone, no more running to answer the phone and so on.

Such a system could be extended to provide a full home security system, with computer interfacing as well. You could be able to connect a computer modem to any handset so that any member of the household could connect to the outside world. How long before we see such a product marketed I wonder?

Further into the future, with the advent of highly compressed video and optical fibres, it seems likely that video phones are just a matter of time. It is not hard to envisage several or most rooms of a household having a video terminal which will do everything: provide entertainment, phone and computer services, the whole bit.

There are more variants on this theme but essentially they are all derivatives of the humble telephone. Who would have thought we want or need more telephones?

Leo Simpson

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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MAILBAG

Old house wiring is often dangerous

I would like to comment on your Publisher's Letter, November 1995, on the subject of house wiring safety. Congratulations for raising this subject. You state the house was built before 1950. This is significant. You express surprise that the study power point was not earthed. At the time the house was wired, unless the room was considered an earthed situation, the wiring regulations did not require earthing of the power point. This would also apply to most bedrooms.

It was not until the 1960 wiring rules that earthing was mandatory. I was employed as a Supply Authority Inspector from 1966 until retirement. While working in a country power station in the 1950s, we received pages of interpretations on the wiring rules, including three pages explaining where earthing was required or not.

I could never understand the type of thinking that permitted and perpetuated non-earthing of power points. It is virtually a booby trap for someone. The installation of a circuit breaker switchboard with old wiring would have been a good first move towards a complete rewire.

R. Brownjohn,
Charlton, Vic.

Pinking vs pinging: which is correct?

I notice that in his article on "Knock Sensing" (SILICON CHIP, December 1995), Julian Edgar refers to the term "pinging" as "a light, barely observable knock". Although this term is widely used, it is not correct.

In a package put out by the ABC a few years ago, called "Know Your Car", the speaker refers to this phenomenon as "pinking". I thought that this was a language problem at the time, so I checked and found that he was correct. I double checked today in the Macquarie Dictionary and see that it seems to be still right. This may not be really important but I feel that Julian would appreciate the point. I would also like to thank him for his many interesting and informative articles.

L. Cook,
Numurkah, Vic.

Comment: the Macquarie Dictionary gives both terms as descriptive of knocking. We prefer "pinging" as it seems to be the most widely used in the trade. "Pinging" is also more precise in terms of onomatopoeia – it imitates the actual sound.

Oxygen sensor is the hard way

Your fuel injector article in November was interesting but, given the simple way the mixture or "burn" of the typical aircraft piston engine is sensed, controlling it by exhaust oxygen seems to be the hard way. Especially with lower-powered, carburetted mills, exhaust gas temperature (EGT), metered with a simple thermocouple, is often used to gauge the burn. The latter is leaned out until EGT peaks, indicating maximum combustion heat and least fuel flow at the extant throttle setting.

If cylinder head temperature, sensed by a couple on the hottest jug, is too high, the burn is richened to cool it down. (On larger mills, the mixture control is usually set to auto lean). Jug temperature alone can be used but either ploy optimises shaft horsepower for the fuel used. Although such a mill may run with near-constant parameters for some hours (easing the problem), why wouldn't EGT controllers work as well for autos?

G. Lindley,
Redfern, NSW.

Comment: your remarks about the ease of monitoring exhaust temperature are no doubt correct but the reason for monitoring exhaust oxygen content is to obtain the best compromise between carbon monoxide on the one hand and nitrogen oxides (NO_x) on the other. Simply maximising exhaust temperature will lead to excessive nitrogen oxide production.

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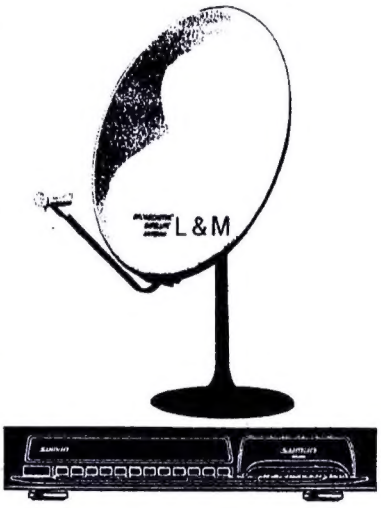

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The do's & don'ts of

Living with engine-managed

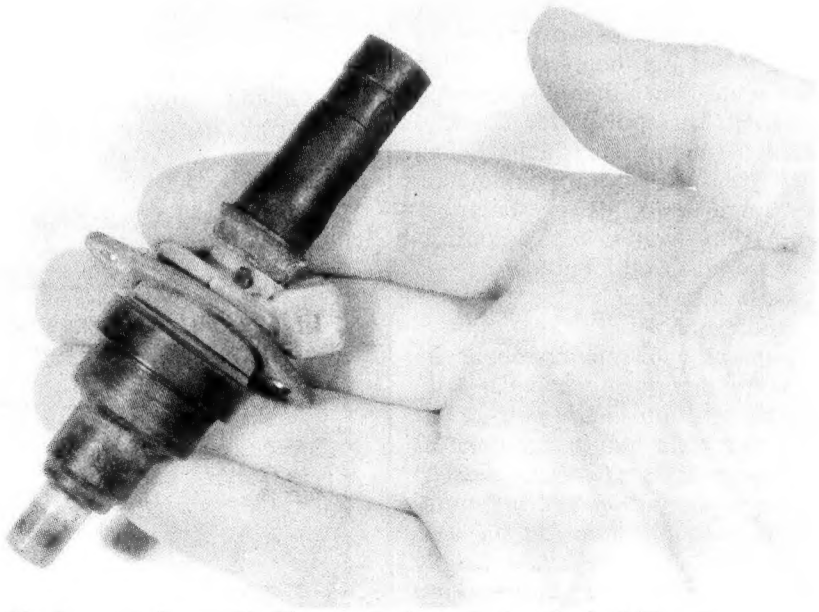
While over the last few years we've covered in detail the technical make-up of current cars' electronic engine control systems, a more general treatment of what the average owner should and should not do with their car has been lacking. Here's the remedy!

By JULIAN EDGAR

In general, the engineers employed by the car manufacturers really do know best – they're the people who have worked with the investment of millions of dollars in developing the technology. This means that the maintenance schedule laid out in the owners' manual should be followed to the letter. It doesn't, however, necessarily mean that the official dealer needs to do the servicing of the car.

Many dealer mechanics in my experience are quite ignorant about the cars for which they're supposed to be experts and do quite illogical things in response to perceived problems. An example of this is where, during a routine service, a dealer-trained mechanic instigated an ECU self-check investigation because he thought that the exhaust note of my car 'sounded funny'. Given that the car runs a modified 75cm diameter exhaust with free-flow mufflers, it wasn't surprising that the exhaust note was non-standard! But checking this by using the self-diagnosis function of the ECU...?

Having said this, there are some mechanics who really do take their marque to heart and have an incredibly detailed knowledge about their cars. If you find such a mechanic stick with him (or her) but unfortunately they are few and far between.



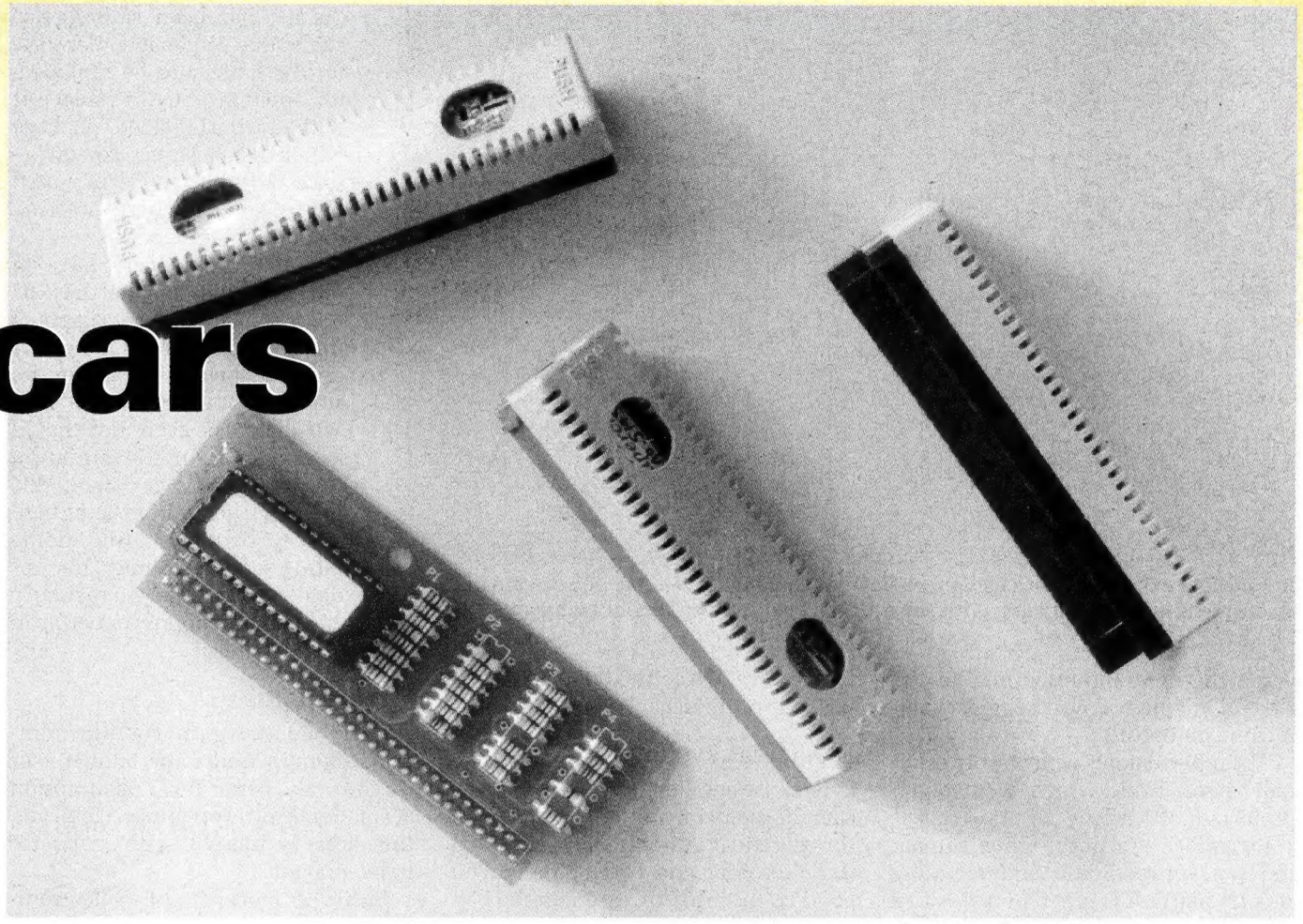
Injector blockage can be avoided by regularly replacing the fuel filter. In addition, injector removal and back-flushing every 50,000km or so can be a worthwhile service precaution.

General maintenance

The frequently advertised invitations to use oil additives or "upper cylinder lubricant" can generally be ignored – unless specified in the official maintenance schedule. However, the occasional use of an in-tank injector cleaning additive can be a worthwhile addition to the manufacturer's recommendations. Also, about every 50,000km or so, the injectors can be removed and back-flushed to clean their inbuilt filters.

However, note that injector problems are much more likely to occur if the fuel filter is not changed at the recommended service intervals. I've not bothered having the injectors removed for cleaning in any of my six EFI cars (some with more than 170,000km on the clock) but note that I have regularly changed the fuel filter.

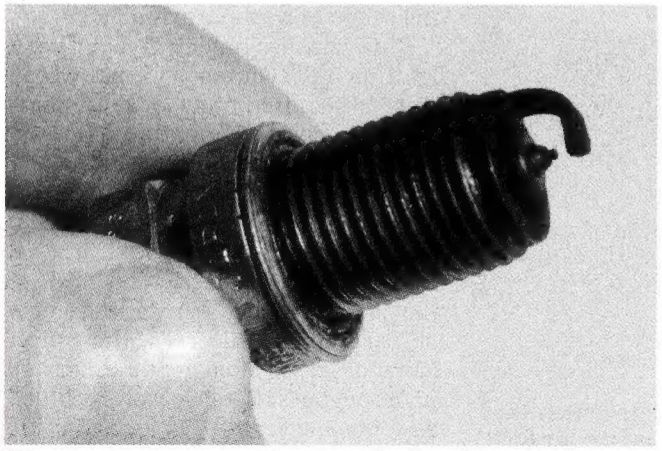
Most engine-managed cars use high combustion pressures to achieve efficiency (and so fuel economy) gains.



Changing the ECU's main memory chip is unlikely to give any noticeable improvement in power, with independent tests showing that losses are as likely as gains.

Firing the spark with high cylinder pressures requires a high-energy ignition system and these do not respond happily to high tension leads which are losing their insulation integrity. The best replacements for worn leads are usually the original equipment products – unless they are terribly expensive. But surely a set drawn from the plethora of aftermarket leads would give better results? An example tells an interesting story.

I once covered the building of a very powerful Nissan FJ20 turbo four cylinder engine. Having a standard power of 200bhp, this particular race unit used a new turbo, was run on methanol using fully-programmable engine management and ended up producing just over 400bhp! Some very high-tech spark plug leads were initially tried but were soon discarded



Many current cars require a spark plug change only every 50,000 or 100,000 kilometres. Reducing the quality of the replacement plug will result in poor performance.

High energy ignition systems place great demands on the ignition leads. Experience has shown that the original equipment leads are often the best.

A modified exhaust system using free-flow mufflers will result in power gains in electronically managed cars, with the average peak-power benefit being about 10%.

when the dyno-mounted engine put on a full display of pyrotechnics when it came on boost!

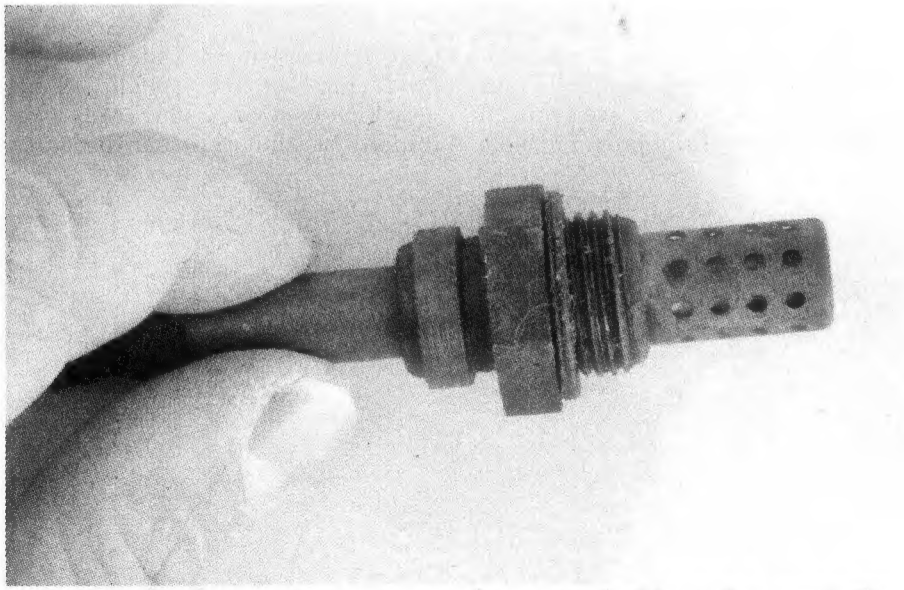
The replacements were the old original Nissan leads which went on to perform faultlessly.

Likewise, be careful when replacing spark-plugs. Some manufacturers specify platinum-tipped plugs, with a service interval of 50,000 or 100,000 kilometres. When they come due for replacement they will be expensive but they will also go on to perform for the next 50,000 or 100,000 kilometres without problems!

Electrical system

Because engine-managed cars place a larger-than-conventional demand on the electrical system, make sure that the alternator and battery remain in good condition. Corrosion on the battery terminals can result in more than just poor headlight performance and it can be illuminating to feel the temperature of the battery terminals after the car has been running for some time. When it comes time for the battery to be replaced, it's advantageous to replace it with a similar-sized package which has a larger capacity – especially if you live in a cold environment where starting loads will be high.

If your car does not have an on-dash indication that the ECU has logged a problem (that is, if there is no "Check Engine" or equivalent warning light), make sure that you perform an ECU self-diagnosis each time the oil is changed. In the situation where it has a problem, this prevents the car from being constantly driven in limp-home mode – which may be undetectable unless you regularly check fuel economy or performance figures.



One reason that frequent tune-ups are no longer required in modern cars is the presence of an exhaust gas oxygen sensor. This constantly indicates the air/fuel mixture strength to the ECU. The changes made to injector pulse widths as the result of this information allows the system to take into account changing parameters such as engine wear.

Engine mods

Everyone likes getting a little additional oomph under the bonnet – or its corollary, better fuel consumption at smaller throttle openings. However, this area is fraught with traps for naive players.

Basically, modification of electronically engine managed cars can be divided into four different categories: (1) chip changes in otherwise standard engines; (2) inlet and exhaust changes; (3) turbocharger boost pressure changes (obviously, only in turbo engines); and (4) major mechanical modifications (porting, cams, compression ratio and so on).

The last item on the list can result in substantial gains in engine power but its detailed examination is beyond the scope of this magazine.

Chip changes (which give different ignition and fuel maps to that which exist as standard) may look attractive but in general give little or no real benefit. In fact, in some cases the performance can actually be worsened! Chassis dynamometer testing of a variety of ECU chips installed in a VR V6 Commodore gives a good guide to the changes made by installing a new chip alone. In this case, the power gains or losses at each 500 RPM step in the engine's rev range were recorded and then averaged. The results are shown in Table 1, the comparison being against the standard Holden chip.

As can be seen, there was a greater

Table 1: Chip Substitution Results	
Chip	Average Gain Or Loss Across Rev Range
A	1.6% loss
B	1.7% loss
C	1.0% gain
D	1.9% loss
E	0.6% gain
Standard Chip + PULP	1.9% gain

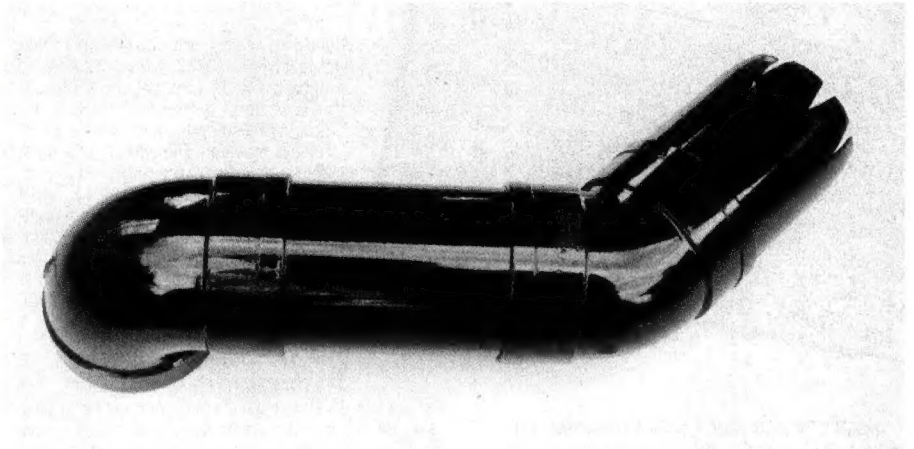
overall power gain (1.9%) made by simply filling the tank with premium unleaded petrol (PULP) while retaining the standard chip! And a gain of just 1.9% is quite trivial. In short, making just a chip change (in a car which doesn't use forced induction) is likely to make no discernible difference to its performance. This is not the case when mechanical modifications have been made, where the fuel and ignition requirements may well have changed from standard.

Intake and exhaust changes can improve power and economy. Fitting extractors and a larger exhaust system will improve peak power output by approximately 10% in most late-model cars. Fuel economy will also be improved, with a gain of 10-20% realisable in country running. Incidentally, the noise output of the exhaust will also increase but this may not be discernible from within the cabin.

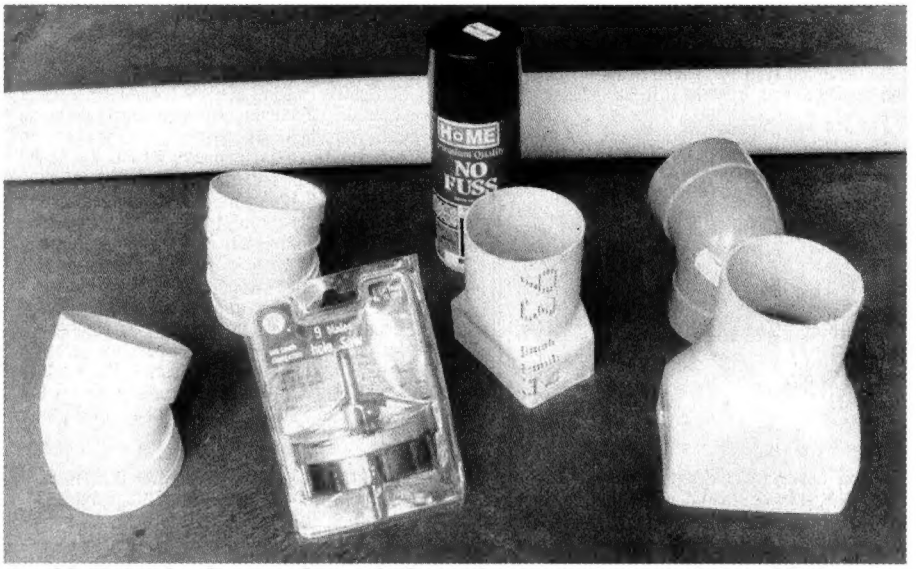
Changing the air filter in the standard box – as is advocated in numerous magazine advertisements – will gain very little power and in some cases will actually reduce power. Chassis dyno tests undertaken on both a late-model Falcon and a late-model Commodore showed, if anything, power reductions with a top aftermarket filter installed in the box. And that was in comparison with a dirty standard filter!

Ducting cold outside air to the filter's air box will improve power in many EFI cars. Using plastic stormwater pipe and fittings (painted black) is an efficient and cost-effective way of doing this. If a new air pick-up point is used, more frequent changing of the air filter element may be needed, as a greater quantity of dust is ingested. However, power gains of 5% are easily achieved in this way for under $50.

Lifting turbo boost pressure by 20-30% in turbo cars will invariably result in an increase in engine power, with no negatives to speak of. If you undertake this course of action, fuel with an appropriate octane rating (for example, premium unleaded) will usually need to be used but there will be no other costs while an agreeable increase in power will be realised. Note that there is usually no need for ECU software changes – sufficient latitude has been built into the fuel system to cope with this type of increase in power.



Ducting cold air into the standard air filter box can result in power gains of 5% for less than $50. The trade-off is the requirement for more frequent air filter changes as more dust is usually ingested.



A cold air intake duct can be made from plastic stormwater pipe and fittings, painted black with a spray-can. The hole saw was used to cut a path through the inner guard.

Conclusion

The electronic side of current cars is usually much more reliable than the old-tech equivalent systems. This generalisation isn't always the case, of course but most engine-managed cars will run reliably for 150,000km+ without even the need for a traditional tune-up.

Incidentally, if paying large amounts for a tune, ask what is actually being done. In most current cars there's no need for plug changes, points re-gapping, mixture adjustment and so on and so a "full tune" can sometimes involve just an oil and filter change, together with a quick visual once-over.

In terms of gaining more power easily, in non-turbo cars the fitting of a good exhaust and extractors will give the best cost/benefit. In turbo cars, fit the modified exhaust and also lift turbo boost a little. **SC**

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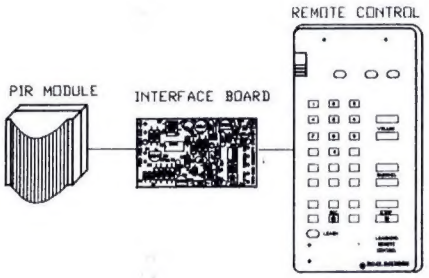

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Ref: EA Nov 93. Our smallest FM transmitter kit. Typical range is about 50m. Stable design, although not as stable to handling as our MkII kit. Has high audio sensitivity. Circuit has two transistors. The complete transmitter PCB (miniature electret microphone included) is the size of an "AA" battery and it is powered by a single "AA" battery. We use a two "AA" battery holder (included in kit) for the case and a battery clip (shorted) for the switch. Estimated battery life is over 500 hours. PCB: 46 x 15mm: **$12 ea. or 3 for $33 (K10).**

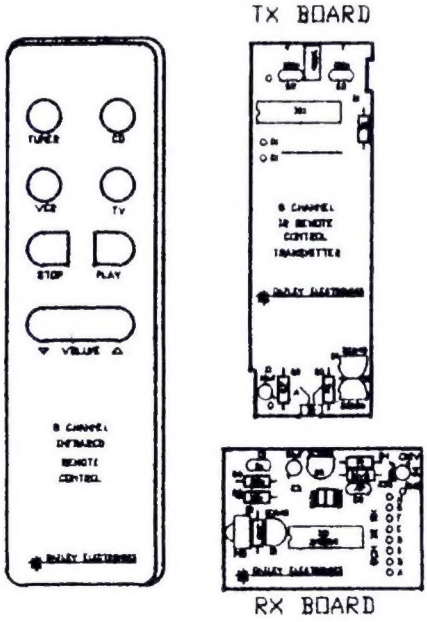
FM TRANSMITTER KIT MKII

Ref: SC Oct 93. This low cost FM transmitter features pre-emphasis, high audio sensitivity (easily picks up normal conversation in a large room), a range of around 100 metres and excellent frequency stability. The specifications are as follows: tuning range: 88-108MHz, supply voltage 6-12V, current consumption @ 9V: 3.5mA, pre-emphasis: 75µs, frequency response: 40Hz to greater than 15kHz, S/N ratio greater than 60dB, sensitivity for full deviation: 20mV, frequency stability with extreme antenna movements 0.03%, PCB dimensions 25 x 43mm. Construction is easy and no coil winding is necessary as the coil is pre-assembled in a shielded metal can. The solder masked and screened PCB also makes for easy construction. The kit includes a PCB and all the on-board components, an electret microphone and a 9V battery clip. **$12 ea. or buy 3 for $33.**

LOW COST 8 CHANNEL IR REMOTE CONTROL

AN EIGHT CHANNEL REMOTE CONTROL TRANSMITTER AND RECEIVER FOR A TOTAL OF $36!!. This kit converts a brand new compact CD IR remote control, into an IR remote using a multichannel encoder IC. We simply use the commercial housing and 8 keys, and replace the existing transmitter PCB with our PCB. The receiver employs a high quality, high sensitivity IR receiver module (up to 15m RANGE!) and a matching decoding IC. There are 8 outputs. Two of these are toggling outputs. The other six are momentary outputs (ie output is on only whilst corresponding transmitter button is pressed). To convert the TTL momentary outputs to drive a relay, or a latching relay, you could use our "4ch relay kit": Information follows. The system also features a Customer Code with 4 combinations making it possible to use up to four systems in the same room/layout, or the possibility to extend the total number of channels to 32! Transmitter PCB: 89 x 30mm. Receiver PCB: 48 x 34mm.

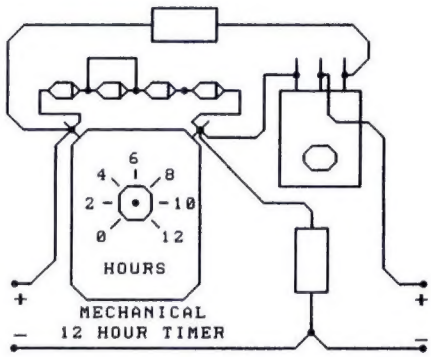
Transmitter kit: $18. Receiver kit: $18.



The above mentioned 4CH RELAY KIT was published in SC (Circuit Notebook) Aug 95. This kit drives any of four relays according to logic level input voltage to any of the four inputs. The relays can be arranged for either toggling operation or momentary operation whenever a "one" logic level is inputted. Very low "stand-by" current. Four LEDs indicate when each relay is switched on. The relays have a contact current rating of 2A. 12V operation. PCB: 100 x 100mm: **$25 (K68).**

BATTERY CHARGER WITH MECHANICAL TIMER

Simple kit which is based on a commercial 12 hour mechanical timer switch which sets the battery charging period from 0 to 12 hrs. Timer clock mechanism is wound-up and started by turning the knob to the desired time setting. Linear dial with 2hrs. timing per



45 deg of rotation, eg 270 deg rotation for 12hr. setting. The contacts on the timer are used to switch on a simple constant current source. Employs a power transistor and 5 additional components. Can easily be "hard wired". We supply a circuit, a wiring diagram, and tables showing how to select the charging current: changing one resistor value. Ideal for most rechargeable batteries. As an example most gel cells can be charged at a current which is equal to the battery capacity rating divided by 5-10. Therefore if you have a discharged gel cell that has 5Ah capacity and are using a charge current of 500mA, the timer should be set for about 11 hours (which includes 10% overtime), or 5.5 hours @ 1A. This circuit is suitable for up to approximately 5A, but additional heatsinking would be required at currents greater than 2A. Parts and instructions are only supplied in this kit. Includes a hobby box with aluminium cover that doubles up as a heatsink, timer switch, large knob, power transistor and a few other small components to give you a wide selection of charge current. You will also need a DC supply with an output voltage which is greater by about 2V than the highest battery voltage you need to charge. As an example a cheap standard car battery charger could be used as the power source to charge any chargeable battery with a voltage range of 0-15V:

$15

27MHz RECEIVERS

Brand new military grade 27MHz single channel telemetry receivers. Enclosed in waterproof die cast metal boxes, telescopic antenna supplied. 270 x 145 x 65mm 2.8kg. Two separate PCBs: receiver PCB has audio output; signal filter/squelch PCB is used to detect various tones. Circuit provided: **$20.**

LIMITED SPECIALS

New 6J7 and 6AV6 valves: **$6 ea. or 10 for $40** (Mix OK) * New large (150 x 150 mm face) square professional moving iron 1500A AC current meter movements with mounting hardware, need current transformer which is not supplied, basic movement 5A for 750A reading: **$18** * One only used Tektronix 434 dual trace 25MHz storage CRO: **$590** * Two only brand new military grade FLYING INTERCOMS made by MARCONI MARINE, two headsets plus two matching control units, incredible quality: **$330 for the lot** * Three only FLUKE 803B Differential AC-DC voltmeters: **$65.**

CCD CAMERA

Very small PCB CCD Camera including Auto Iris lens: 0.1Lux, 320K pixels, IR responsive, has 6 IR LEDs on PCB. Slightly bigger than a box of matches!: **$180.**

VISIBLE LASER DIODE KIT

A 5mW/670nM visible laser diode plus a collimating lens, plus a housing, plus an APC driver kit (Sept 94 EA). **UNBELIEVABLE PRICE: $40.** Suitable case & battery holder to make pointer as in EA Nov 95 $5 extra.

12V-2.5 WATT SOLAR PANEL KITS

These US made amorphous glass solar panels only need terminating and weather proofing. We provide clips and backing glass. Very easy to complete. Dimensions: 305 x 228mm, Vo-c: 18-20V, Is-c: 250mA. **SPECIAL PRICE: $20 ea. or 4 for $60.** A very efficient switching regulator kit is available: suits 12-24V batteries, 0.1-16A panels, $27. Also available is a simple & efficient shunt regulator kit, $5.

SOLID STATE "PELTIER EFFECT" DEVICES SPECIAL

We have reduced the price of our peltiers! These can be used to make a solid state thermoelectric cooler/heater. Basic information supplied: 12V-4.4A PELTIER DEVICE: $25. We can also provide two thermal cutout switches, and a 12V DC fan to suit either of the above, for an additional price of $10.

LEARNING - UNIVERSAL REMOTE CONTROL

These Learning IR Remote Controls can be used to replace up to eight dedicated IR Remote Controls: **$45.**

HELIUM - NEON LASER BARGAIN

Helium Neon 633nM red laser heads (ie tubes sealed in a tubular metal case with an inbuilt ballast resistor) that were removed from equipment that is less than 5 years old. These are suitable for light shows. Output power is in the range of 2.5-7.5mW. Heads are grouped according to output power range. Dimensions of the head are 380mm long and 45mm diameter. Weight: 0.6kg. A special high voltage supply is required to operate these heads. With each tube we will include our 12V Universal Laser power supply kit MkIV (our new transformers don't fail). Warning: involves high voltage operation at a very dangerous energy level. **SUPER SPECIAL: $80 for a 2.5-4.0mW tube and supply. $130 for a 4.0-6.5mW tube and supply.** This combination will require a source of 12V @ at least 2.0A. A 12V gel battery or car battery is suitable, or if 240V operation is required our Wang computer power supply (cat number P01) is ideal. Our SPECIAL PRICE for the Wang power supply when purchased with matching laser head/inverter kit is an additional $10.

ARGON-ION HEADS

Used Argon-Ion heads with 30-100mW output in the blue - green spectrum. Head only supplied. Needs 3Vac @ 15A for the filament and approx 100Vdc @ 10A into the driver circuitry that is built into the head. We provide a circuit for a suitable power supply the main cost of which is for the large transformer required: $170 from the mentioned supplier. Basic information on power supply provided. Dimensions: 35 x 16 x 16cm. Weight: 5.9kg. 1 year guarantee on head. Price graded according to hours on the hour meter. We had no serious problems with any of these heads as they were used at a very low current in their original application. Argon heads only, 4 to 8 thousand hours: **$350.** Argon heads only, 8 to 13 thousand hours: **$250.**

MASTHEAD AMPLIFIER SPECIAL

High performance low noise masthead amplifier covers VHF-FM UHF and is based on a MAR-6 IC. Includes two PCBs, all on-board components. For a limited time we will also include a suitable plugpack to power the amplifier from mains for a total price of: $25.

COMPUTER CONTROLLED STEPPER MOTOR DRIVER KIT

This kit will drive two 4, 5, 6 or 8 wire stepper motors from an IBM computer parallel port. The motors require a separate power supply (not included). A detailed manual on the computer control of motors plus circuit diagrams and descriptions are provided. Software is also supplied, on a 3.5" disk. PCB: 153 x 45mm. Great low cost educational kit. We provide the PCB and all on-board components kit, manual, disk with software, plus two stepper motors of your choice for a special price. Choose motors from M17/M18/M35. **$44.** Kit without motors is also available: **$32.**

LOW COST IR ILLUMINATOR

Illuminates night viewers or CCD cameras using 42 of our 880nm/30mW/12 degrees IR LEDs. Power output (and power consumption) is variable, using a trimpotentiometer. Operates from 10 to 15V and consumes from 5mA up to 0.6A (at maximum power). The LEDs are arranged into 6 strings of 7 series LEDs with each string controlled by an adjustable constant current source. PCB: 83 x 52mm: **$40 (K36).**

VHF MODULATOR FOR B/W CAMERAS

(To be published, EA) Simple modulator which can be adjusted to operate between about channels 7 & 11 in the VHF TV band. This is designed for use in conjunction with monochrome CCD cameras to give adequate results with a cheap TV. The incoming video simply directly modulates the VHF oscillator. This allows operation with a TV without the necessity of connecting up wires, if not desired, by simply placing the modulator within about 50cm from the TV antenna. Suits PAL and NTSC systems. PCB: 63 x 37mm: **$12 (K63).**

SOUND FOR CCD CAMERAS/UNIVERSAL AMPLIFIER

(To be published, EA). Uses an LM386 audio amplifier IC & a BC548 pre-amp. Signals picked up from an electret microphone are amplified & drives a speaker. Intended for use for listening to sound in the location of a CCD camera installation, but this kit could be used as a simple utility amp. Very high audio gain (adjustable) makes this unit suitable for use with directional parabolic reflectors etc. PCB: 63 x 37mm: **$10 (K64).**

LOW COST 1 to 2 CHANNEL UHF REMOTE CONTROL

(To be published, SC) A single channel 304MHz UHF remote control with over 1/2 million code combinations, which also makes provision for a second channel expansion. The low cost design has a 2A relay contact output. The 1ch transmitter (K41) can be used to control one channel of the receiver. To access the second channel when another transmitter is purchased, the other transmitter is coded differently. Alternatively, the 3ch transmitter kit (K40) as used with the 4ch receiver kit is compatible with this receiver and allows access to both channels from the one transmitter. Note that the receiver uses two separate decoder ICs. This receiver operates from 10 to 15Vdc. Range is up to about 40m. 1ch Rx kit: **$22 (K26).** Expansion components (to convert the receiver to 2 channel operation; extra decoder IC and relay): $6.

ONE CHANNEL UHF TRANSMITTER

AX5326 encoder. Transmit frequency adjustable by trimcap. Centred around 304MHz. Powered from 12V lighter battery. LED flashes when transmitting. Size of transmitter case: 67 x 30 x 13 mm. This kit is trickier to assemble than the 3ch UHF transmitter: **$11.**

NEW CATALOGUE

Our new catalogue will be available in January 96. Ask for a FREE copy to be included with your next order.

THREE CHANNEL UHF TRANSMITTER

The same basic circuit as the 1ch transmitter. Two buttons, allows up to 3 channel operation. Easier to assemble than the 1ch transmitter and has slightly greater range. Size of transmitter case: 54 x 36 x 15mm: **$18.**

MAGNETIC CARD READER

Commercial cased unit that will read some information from most plastic cards, needs 8 to 12V DC supply such as a plugpack. Draws about 400mA. Power input socket is 2.5mm DC power type. Weight: 850g. 220 x 160 x 45mm: **$70 (Cat G05).**

VISIBLE LASER DIODE MODULES

Industrial quality 5mW/670nM laser diode modules. Consists of a visible laser diode, diode housing, driver circuit, and collimation lens all factory assembled in one small module. Features an automatic power control circuit (APC) driver, so brightness varies little with changes in supply voltage or temperature. Requires 3 to 5V to operate and consumes approx 50mA. Note: 5V must not be exceeded and there must be no ripple on the power supply, or the module may be instantly destroyed. These items may require licensing. Overall dimensions: 12mm diameter by 43mm long. Assembled into an anodised aluminium casing. This module has a superior collimating optic. Divergence angle is less than 1milliradian. Spot size is typically 20mm in diameter at 30 metres: **$65.** This unit may also be available with a 635nm Laser Diode fitted.

CYCLE/VEHICLE COMPUTERS

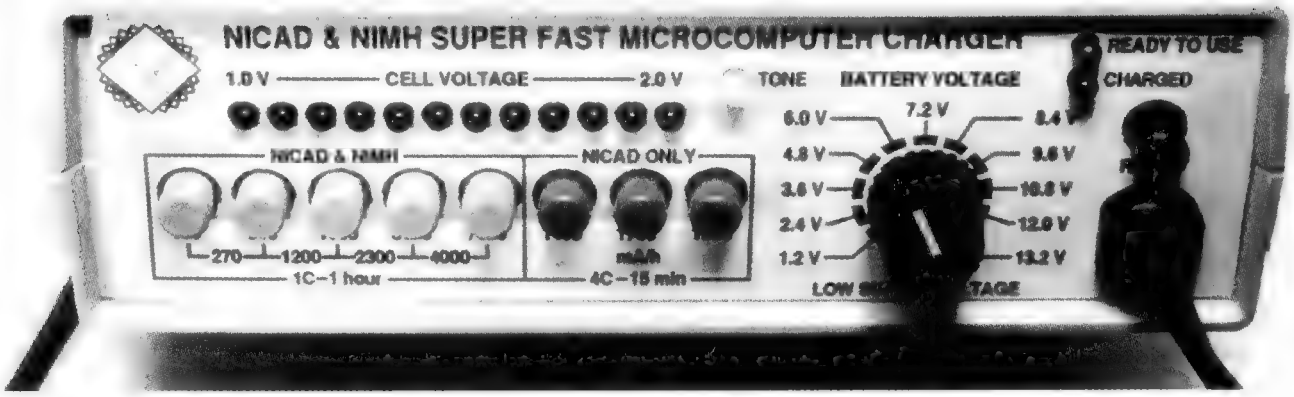
BRAND NEW SOLAR POWERED MODEL! Intended for bicycles, but with some ingenuity could be adapted to any moving vehicle with a rotating wheel. Could also be used with an old bicycle wheel to make a distance measuring wheel. Top of the range model. Weather and shock resistant. Functions: speedometer, average speed, maximum speed, tripmeter, odometer, auto trip timer, scan, freeze frame memory, clock. Programmable to allow operation with almost any wheel diameter. Uses a small spoke-mounted magnet, with a Hall effect switch fixed to the forks which detects each time the magnet passes. Hall effect switch is linked to the small main unit mounted on the handlebars via a cable. Readout at main unit is via an LCD display. Main unit can be unclipped from the handlebar mounting to prevent it being stolen,& weighs only 30g. Max speed reading: 160km/h. Max odometer reading: 9999km. Maximum tripmeter reading: 999.9km. Dimensions of main unit: 64 x 50 x 19mm: **$32 (Cat G16).**

EMAIL WEBSITE

EMAIL address: oatley@world.net until Mar.96, oatley@ozemail.com.au from Feb.96.

WEB SITE address: over 300 kits plus our catalogue: http://www.hk.super.net/~diykit

New from Smart Fastchargers, this nicad and NiMH charger caters for a wide range of battery voltages and capacities and uses the patented Reflex charging method. It has eight buttons to set the rate of charge, a rotary switch to select the battery voltage and a LED bargraph to indicate the cell voltage. An audible beep, at one second intervals, gives an indication that the main charge is still in progress.



Recharging nicad batteries for long life

Nickel cadmium and nickel metal hydride batteries are widely used in all sorts of portable equipment but they often don't last long before they must be replaced. One solution is to use "burp charging" which is claimed to provide many thousands of charge/discharge cycles.

By HORST REUTER*

Battery powered equipment is undeniably practical – lightweight, portable and small, with no cables to drag around. But there is a price to pay for that convenience. Rechargeable batteries are costly to buy and often don't last long. The problem can usually be traced back to the type of charger used.

Unfortunately, most of the nicad chargers supplied with appliances at present require manual termination; ie, the user has to switch off the charger and disconnect the battery. This makes it practically impossible to avoid overcharging the batteries, thereby reducing their life expectancy. The key to long life lies in the charging method.

In this article, a battery is defined as consisting of one cell or several cells connected in series. Internal cell impedance is defined as the sum of the resistance of the internal connections and plates (both constant) and the degree of difficulty the ions encounter passing through the separators and electrolyte (variable).

Nicad or NiMH?

From an environmental point of view it would be an advantage to change to NiMH batteries. Nickel Metal Hydride (NiMH) batteries are made without cadmium and are therefore less damaging to biological systems. At present, they have about 20% higher energy density than nicad cells (AA) and produce no memory effect (more about memory effect later).

However, typical NiMH cells have a higher internal impedance than nicad cells; 50mΩ instead of 10mΩ for 1200mAh cells. As a consequence,

NiMH batteries have lower maximum discharge currents. This means they are only suitable for low current appliances like handheld radios. The maximum discharge current is 3C for NiMH AA cells and 2C for NiMH button cells, whereupon the cell voltage drops to approximately 1.1V. "C" is defined as the current that equals the rated battery capacity. For example, charging a 1.2Ah battery with a 4.8A current is a 4C charge. The same 4.8A current applied to a 4.8Ah battery is a 1C charge.

In practice, the useful discharge currents for NiMH batteries are limited to less than 1C (the cell voltage remains above 1.2V). For currents above 1C, nicad batteries are superior. Fig.1 is a comparison of the load characteristics of one 1200mAh AA size NiMH cell, one 600mAh AA size nicad and one 1200mAh sub-C size nicad cell. The load was only applied for 5 milliseconds.

The tests showed that a fully charged 12V 1200mAh nicad battery as used in power drills delivers a maximum of 11.9V with a 10A load. Even a 12V 600mAh nicad battery delivers a maximum of 10.9V with a 10A load. However, a 1200mAh NiMH battery with the same load delivers only 7.65V.

NiMH batteries also differ from nicad cells in that the chemical reaction during charge is exothermic; ie, the charging process produces heat. The chemical reaction in nicad cells is endothermic; the reaction absorbs heat. However both battery types produce some heat during the main charge cycle because of internal impedance and both produce heat when overcharged. Overcharging creates heat and gas but does not produce any further energy storage in the cells.

The heat produced during the main charge in nicad cells due to cell impedance is absorbed in the endothermic reaction. In NiMH cells, the cell heating due to internal impedance is added to the heat of the exothermic reaction. When NiMH batteries reach the overcharge region, they are therefore hotter than nicads.

All available NiMH cells I have tested vented at around 43-45°C case temperature – much lower than for nicads. This means that charge termination at high charge rates is critical and cannot safely be achieved with delta V termination chargers. The case temperature should not exceed 40°C for NiMH cells and 45°C for nicads.

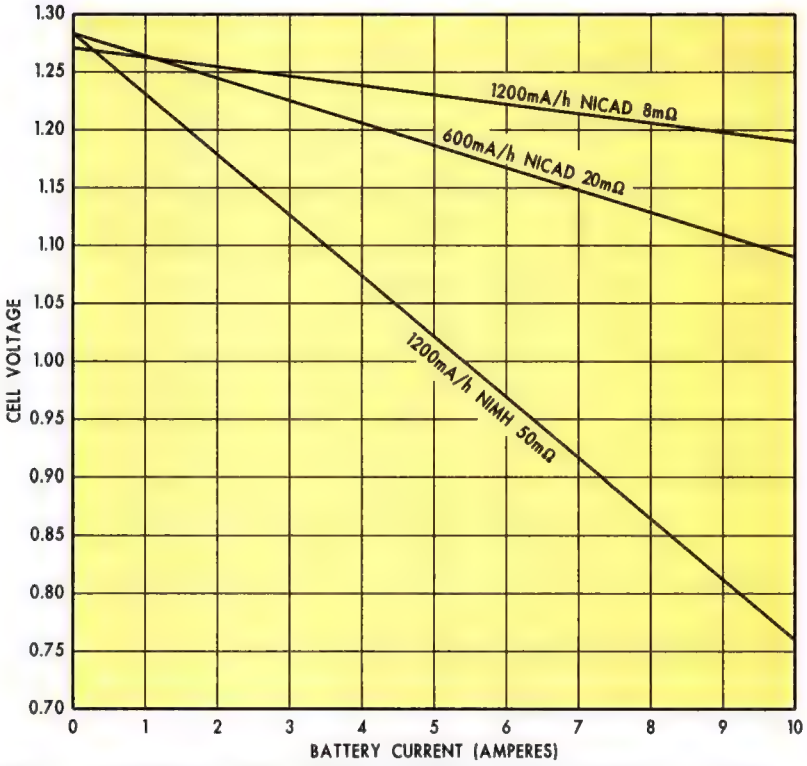


Fig.1: a comparison of the load characteristics of a 1200mAh AA size NiMH cell, a 600mAh AA size nicad and a 1200mAh sub-C size nicad cell. The load was only applied for 5 milliseconds. This clearly demonstrates that the higher internal impedance of NiMH batteries limits their usefulness in delivering high currents.

Delta V termination utilises the voltage drop at the beginning of the overcharge region of the cell voltage curve (see Fig.2). The magnitude of this voltage drop is generally not as well defined in NiMH cells as it is in nicad cells. It depends on factors like charge current, ambient temperature, cell impedance, cell capacity, etc.

The situation can be worse in battery packs. Several unmatched cells may cause the battery voltage to reach only a very shallow peak if some cells reach their individual peaks while others are still charging. Even if the

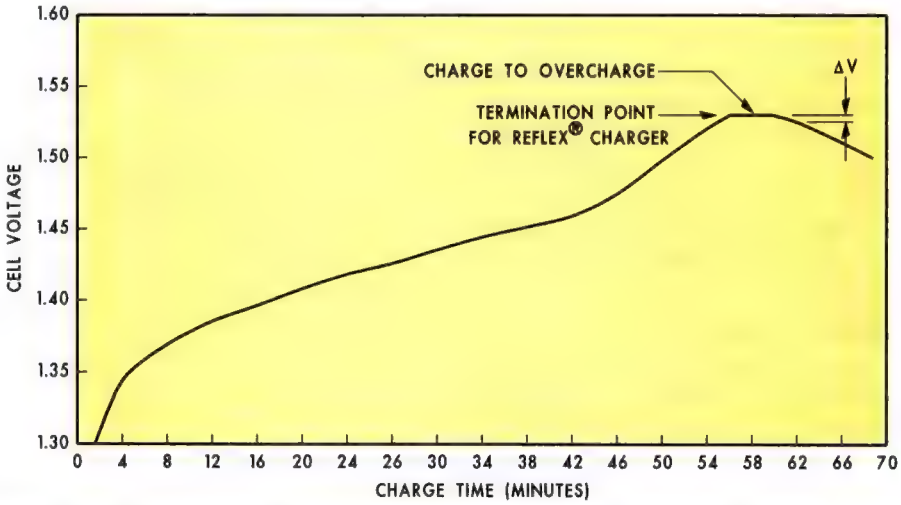


Fig.2: delta V termination utilises the voltage drop at the beginning of the overcharge region of the cell voltage curve. The magnitude of this voltage drop is generally not as well defined in NiMH cells as it is in nicad cells. It depends on factors like charge current, ambient temperature, cell impedance, cell capacity, and so on.

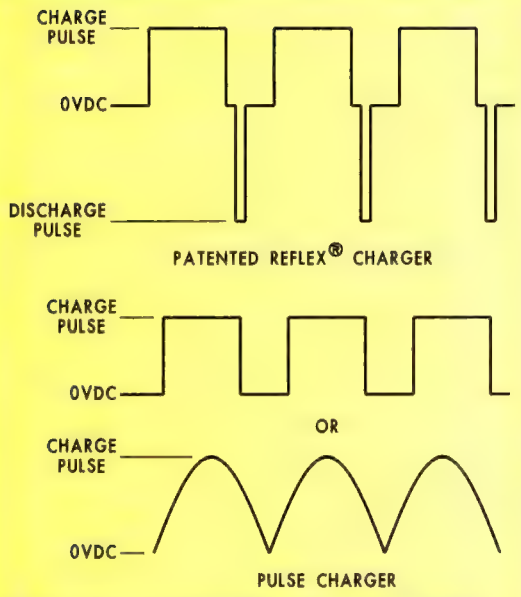


Fig.3: the patented Reflex or "burp" charge method consists of a positive charge pulse followed by a high current, short duration discharge pulse. This is quite different from other chargers which have an essentially pulsed output but no discharge pulses.

charger circuit is able to detect a very small voltage drop (<10mV) at the very start of the overcharge region, the fact remains that we are already operating in the overcharge region.

Overcharging is not acceptable if we want to achieve maximum battery life for nicad cells. For NiMH cells it can be dangerous if used in combination with high charge currents. It can lead to venting and consequent loss of capacity and in extreme cases to cell explosion, due to a build up of gas pressure.

If NiMH cells are charged with delta V termination chargers, then this has to be done at the rate the manufacturer recommends, typically C/10 (120mA) for 1200mAh cells. At this rate, any heat produced during charging and overcharging will be safely dissipated.

Memory effect

Let's look at the major problem of nicad cells: memory effect. This is caused by charging a partially discharged battery and enhanced by slow charging and high operating temperatures. During charging, the negative plate loses oxygen and converts cadmium hydroxide to metallic cadmium, while the positive plate goes to a higher state of oxidation, changing the nickel hydroxide to nickel oxyhydroxide. This process is reversed during discharge.

If each cell in the battery pack is discharged completely and then charged, the individual crystal sizes on the cell plates remain unaltered. However, if the cadmium is not completely converted back into cadmium hydroxide during partial discharge, on the following charge the cadmium hydroxide crystals will clump together, forming larger crystal structures.

Although it is not yet fully understood how this happens, scanning electron micrographs of batteries with and without memory effect clearly show the difference in crystal sizes. The net result is that we are left with a smaller, less reactive surface area and therefore reduced capacity.

The clumping of crystals is mostly a slow process but is cumulative. However, as we will see later, it is reversible.

End point voltage

The usual strategy to prevent memory effect is to discharge each cell to 1.1V or 1.0V, a level where very little useful energy is left. This is only partly effective with single cells and with new and well matched cells in battery packs. Not all cells in a battery pack will age equally or charge and discharge equally at different operating temperatures. In the end, some cells will only be partly discharged when others are deep discharged.

At the final stage of the battery discharge, a sudden substantial voltage drop occurs. This can lead to reverse charging of the weakest cell in a battery pack of more than 12 cells and will still cause a clumping of crystals in all cells (except the weakest cell) during the next charge. The magnitude of memory effect in each cell depends on the depth of discharge.

Unlike some other types of cells, nicads can be totally discharged and then even shorted to avoid the memory effect but not without reducing life expectancy. The life expectancy of all types of batteries, including nicads, is partly dependent on the depth of discharge.

Hence, a total discharge will reduce life expectancy (up to a factor of 10 in cases of frequent total discharge). Totally discharging a battery to 0V – unlike discharging a single cell – is a sure recipe for extremely short battery life due to cell voltage reversal.

Shallow discharge, less than 25% of total capacity, makes for long battery life but creates the conditions for memory effect. A 1.1V or 1.0V discharge voltage is only a compromise, not a magic value.

Freezing cells

Another strategy to combat memory effect, the practice of freezing batteries to break up the clumping of the crystals, creates mechanical stresses in the cells. This can also lead to re-

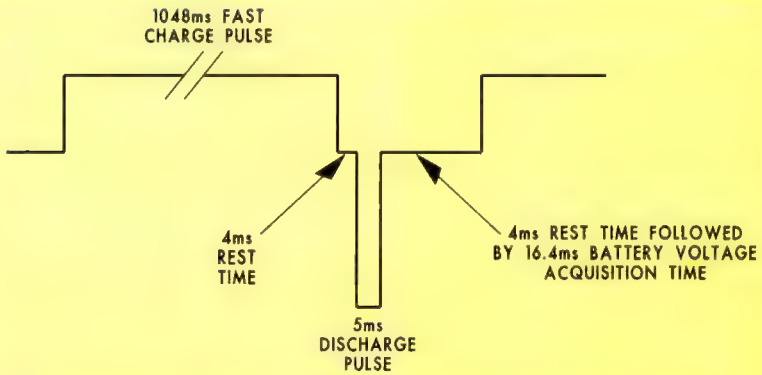
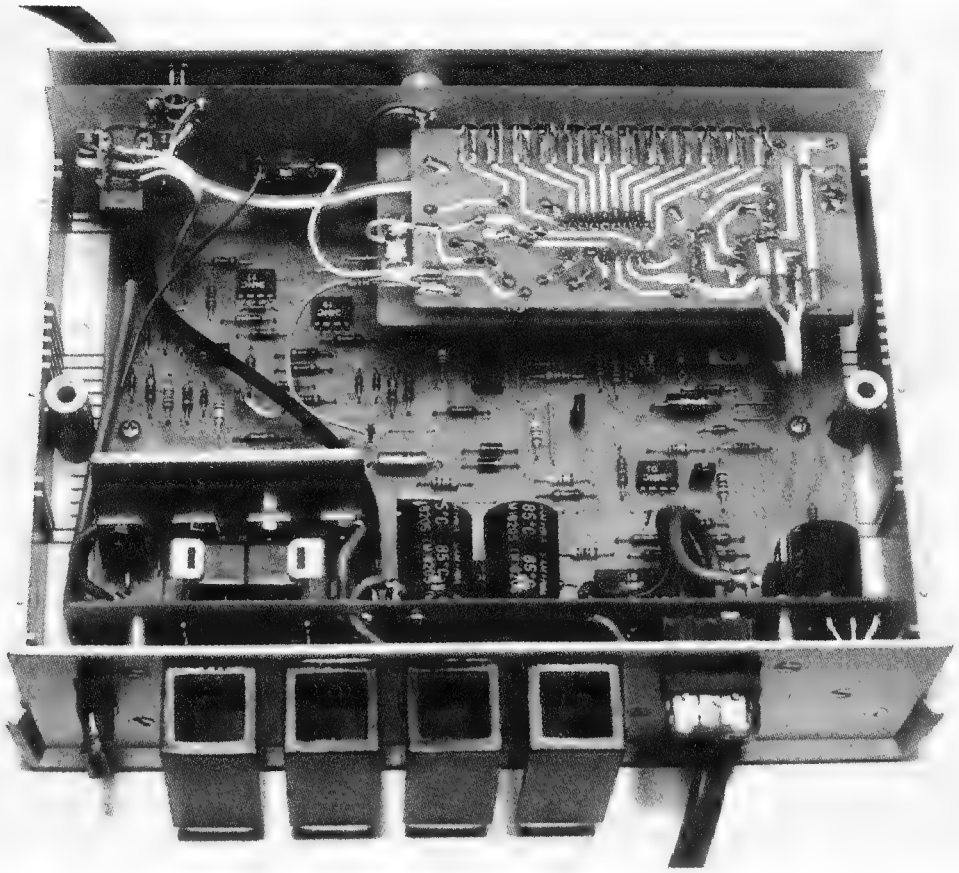


Fig.4: the essential characteristic of the Reflex charging method is a high current charge pulse, followed by a short rest period and then an even higher discharge pulse for 5ms. The battery voltage is then measured before the next charge pulse.



This is the view inside the prototype from Smart Fastchargers. It uses a total of three PC boards and can charge batteries at a rate of up to 9A.

duced life expectancy since a high degree of mechanical precision goes into the production of today's high capacity cells. It is also a time consuming method, since all cells in the battery have to be slowly warmed to above 10°C after freezing for efficient fast charging.

All these are makeshift solutions. The problem should be tackled at the roots, by using a charge method that will reduce crystal size in batteries where crystal clumping has occurred and avoids crystal clumping during the charging of partially discharged batteries.

Another area that needs improvement is the small number of recharge cycles suggested for most nicad batteries. In the case of some hand-held radios, the batteries are supposed to have only 300 recharge cycles. Batteries for other appliances are rated for 500 and 1000 cycles.

Theoretically, 5000 charge/discharge cycles are possible over a minimum life span of 10 years. One power hand tool manufacturer advertises 3000 cycles and 10 minutes charging time. This is achieved by using advanced charger technology and fast charge batteries. 3000 cycles represent approximately 6.5 cents per cycle as compared to 55 cents per cycle for the hand-held radio batteries (at presently quoted prices).

Another problem is the excessive time required to charge nicad and NiMH batteries with delta V termination chargers: generally between one hour for fast charge nicad batteries and 15 hours for standard nicad batteries and NiMH batteries. Only in exceptional cases, as with some chargers for battery powered tools, is it possible to achieve charge rates of less than one hour for nicad batteries.

Burp charging

One overseas company has designed a fast charger that achieves an amount of recharge cycles close to the theoretical limit. This patented charger, well proven in industrial and military applications, is used to charge aircraft batteries, emergency standby batteries for hospitals, etc and operates fully automatically. It automatically detects the type of battery (nicad, NiMH, lead-acid, etc), battery capacity and voltage and adjusts itself accordingly.

These complex chargers use the patented Reflex or BURP charge method. This consists of a positive charge pulse followed by a high current, short duration discharge pulse. This should not be confused with pulse or switchmode chargers which switch the charge current on and off but do not apply a discharge current – see Fig.3.

By using a charger circuit with the patented Reflex method incorporated in a licensed integrated circuit, it is possible to obtain a dramatic increase in the charge/discharge cycles of nicad batteries, to at least 3000 cycles if reasonable care is exercised. There is no need to run appliances until the batteries are flat to avoid the memory effect. It is now possible to recharge the batteries after each use. Partial discharge, as opposed to full discharge, will significantly increase the life of the batteries.

A microprocessor calculates and accurately terminates the applied charge by evaluating the inflection points on the charge voltage curve. The termination point varies according to the charging characteristic of the battery; it occurs just prior to the transition into overcharge (see Fig.2).

The circuit provides a fast charge, preceded by a series of soft start charge pulses. Then, if the battery is left in

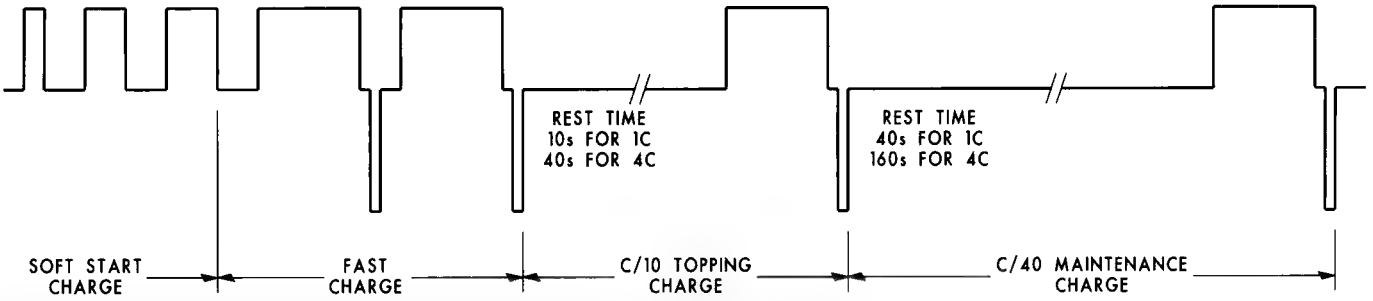


Fig.5: the timing for soft start, fast, topping and maintenance charges. The charge/discharge pulse combination for the topping and maintenance modes remain the same as for the fast charge cycle; only the rest time is changed.

the charger, the fast charge will be followed by a topping charge and a non-destructive indefinite maintenance charge.

All of the above can be done by one charger with an adjustable output current sufficient for batteries of 7000mAh capacity at the 1C (1 hour) charge rate or for 1900mAh capacity batteries at the 4C (15 minute) charge rate, taking the charge efficiency into account. To fully charge a battery, approximately 20% more charge than has been withdrawn has to be put back into the battery if charged at or above C/10 at 20°C.

The charge efficiency of batteries depends on charge current and ambient temperature. High or very low ambient temperatures and/or low charge currents decrease the charge efficiency; in extreme cases to a point where the battery cannot be fully charged.

Soft start

Batteries can exhibit a high impedance during the initial stages of charging. The resulting voltage peak can be interpreted by the processor as a fully charged battery. However, with the soft start cycle, at first only short duration current pulses are applied to the battery. Starting at 200ms, the pulse width is gradually increased to approximately one second in duration. This gradual increase in pulse width takes place over a period of two minutes to avoid voltage peaks.

Fast charge

During the main charge cycle, each positive current pulse is followed by a discharge pulse, as shown in Fig.4. The discharge pulse is 2.5 times the amplitude of the charge pulse. After the main charge, if the battery is left on the charger, it will be fed a topping charge. This charge is at a current low enough to prevent cell heating but high enough to convert all active material in the cells to the charged state.

Due to higher temperatures and gas bubbles (see explanation further on), 100% charge cannot be achieved with fast chargers. Standard constant current chargers create heat and gas bubbles on the cell plates during charging. This results in less than 90% efficiency.

This version of the Reflex charger is approximately 95% efficient, since the termination method largely avoids cell heating and the charge/discharge pulse sequence removes most of the gas bubbles from the cell plates. The 2-hour C/10 charge tops up the battery if the time is available or 100% capacity is required.

Maintenance charge

After the full charge and topping charge, the C/40 charge compensates for the internal self-discharge of the battery, at the same time preventing dendrite formation and maintaining the crystal structure. The battery can remain on the charger until used – there is no time limit. This charge cycle can be useful in standby applications, as in security installations.

Fig.5 shows the timing for soft start, fast, topping and maintenance charges. The charge/discharge pulse combination for the topping and maintenance modes remain the same as for the fast charge cycle; only the rest time is changed.

The removal of gas bubbles from the cell plates during charge keeps the cell impedance low, reduces operating temperature and allows higher charge currents for nicad and NiMH batteries. The following charge times can be achieved: fast-charge nicad batteries in less than 15 minutes at the 4C rate, standard nicad and NiMH batteries in less than one hour.

As well, memory effect in batteries can be eliminated. This works even when the battery no longer holds any charge. It requires a minimum of three complete charge/discharge cycles. A typical case in practice involved a 4.8V 600mAh cellular phone battery pack. This had only 20% of its stated capacity, after it had been used over a period of six months with the supplied charger. After five charge/discharge cycles, it had recovered to approximately 95% of capacity.

The possibility to rejuvenate shorted nicad batteries is also a feature. Whenever a nicad battery has been stored charged and has then slowly self-discharged over a very long period of time at an elevated temperature, or has been charged at a low current over a long period, as in constant current trickle charging in standby applications, crystals on the cell plates can form crystalline fingers, or dendrites, which can propagate through the plate separators and across the cell plates.

In extreme cases, these crystalline dendrites can partially or completely short-circuit a cell. Such cells can be rejuvenated by this charger.

Charger circuit

Fig.6 shows the block diagram of a charger using the patented Reflex charging method. The charger covers a battery voltage range from 1.2V to 13.2V at charge currents from 0.1A to 9.0A. The central part of the battery charger is basically a reduced instruction set microprocessor (RISC) to handle the complex calculations for the charge termination point.

The microprocessor uses an analog-to-digital converter (ADC) with 300µV resolution to convert the battery voltage, normalised to one cell by the input attenuator VR1. The ADC is followed by a filter to limit the effects caused by battery voltage jumps and ADC noise and to eliminate any large

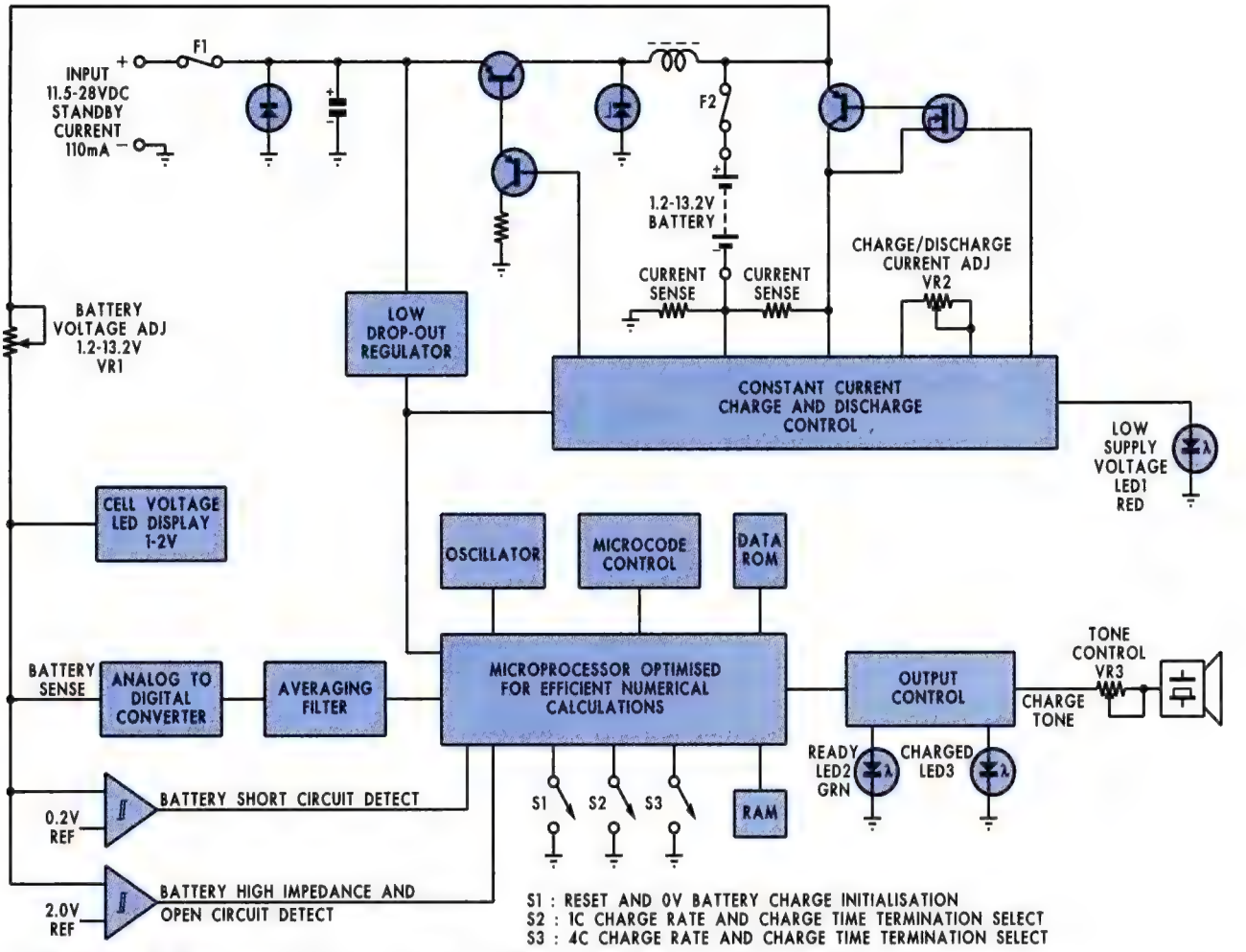


Fig.6: the block diagram of a charger using a RISC microprocessor programmed with the patented Reflex charging method. The charger covers a battery voltage range from 1.2V to 13.2V at charge currents from 0.1A to 9.0A.

aberrations in the battery voltage curve.

The microprocessor controls the charge, topping and maintenance modes. One input of the microprocessor controls the charge rates (1C or 4C) and is linked to the bank of push-buttons for selection of charge current.

One input resets the microprocessor to repeat a charge cycle or to charge shorted cells. In this case, the reset button has to be activated until the LED "cell voltage" display indicates acceptance of the charge current.

A battery voltage guard circuit avoids automatic charging of shorted batteries. This is necessary since the current required to kick start a shorted battery varies from case to case and should be controlled manually.

Another detect circuit avoids the automatic charging of batteries with a voltage or more than 2V per cell. This condition is due to high internal impedance, as found in new batteries that have not been cycled and in some batteries which have been stored for several months. Charging these batteries would cause excessive heating.

The DC input to the charger can range from 11.5V to 28V, depending on the number of cells in the battery to be charged. Essentially, this is a minimum of 2V per cell plus an additional 2V. Hence a 6V battery (5 cells) requires a minimum of 12VDC to the charger while a 12V battery (10 cells) requires a minimum of 22VDC.

Safety cut-off

In case the voltage sensing for end of charge does not work there is a time-out circuit which is set for 72 minutes at the 1C rate and 18 minutes for the 4C rate. In addition, there is a heatsink temperature sensor to interrupt the charge as a safety measure in extreme hot weather conditions.

The microprocessor controls three output circuits and two LED indicators. The charge circuit is a switch-mode current source, adjustable from 0.1A to 9A with VR2 (a bank of push-button switches). The discharge circuit is a pulsed constant current sink adjusted to between 0.25A and 22.5A (2.5 times the charge current).

During the main charge cycle, a small piezo speaker emits a brief tone once a second, synchronised to the discharge pulses. This is a convenient audio cue to tell the user the battery is still in the main charge sequence. The tone control on the front panel actually adjusts the volume, so that the tone is not obtrusive.

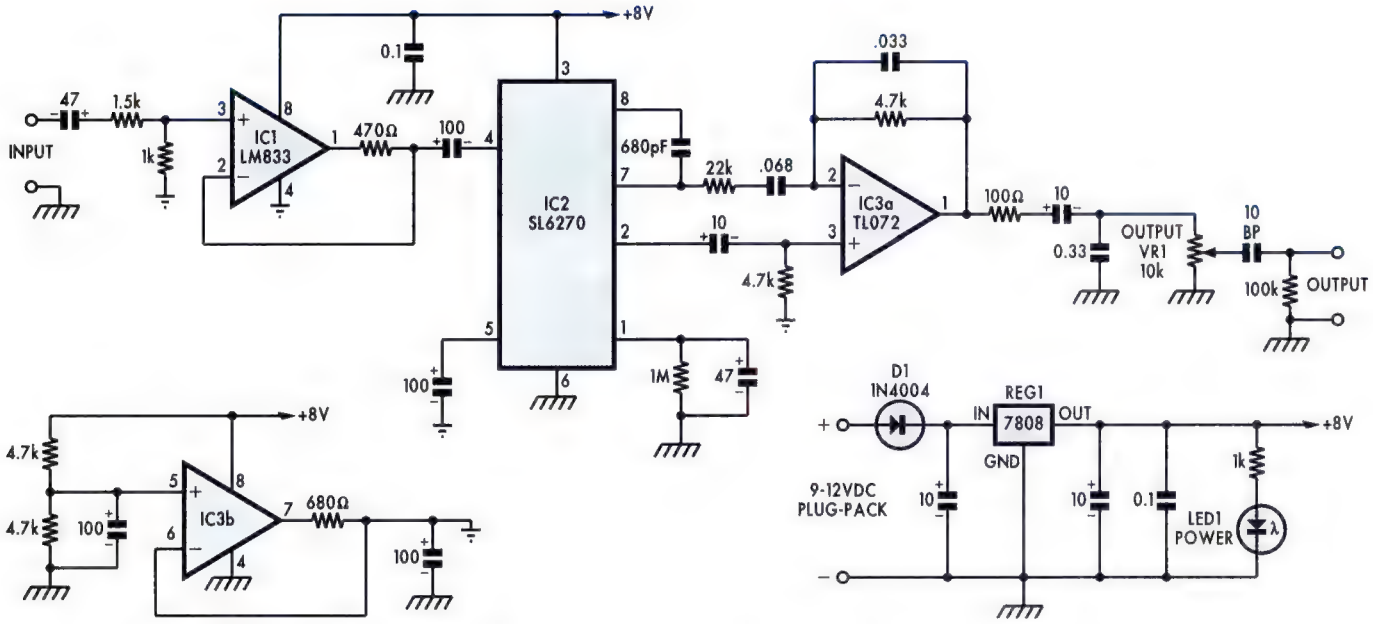
Other details of the operation can be gleaned from the block diagram.

By this time this issue goes on sale, the charger will have been released for sale. For information concerning availability and price, contact Smart Fastchargers, R.S.D. 540, Devonport, Tas 7310. Phone/fax (004) 921 368.

*Horst Reuter is Technical Manager of Smart Fastchargers.

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Automatic level control for line signals

This circuit adapts the Plessey Sl6270 gain control chip to line levels. Intended for automatic level control of balanced microphones, the SL6270 was featured in the August 1995 issue. In this circuit, it will accept up to 1V RMS of signal before clipping and will provide a constant output level for input signals between 14mV and 1V.

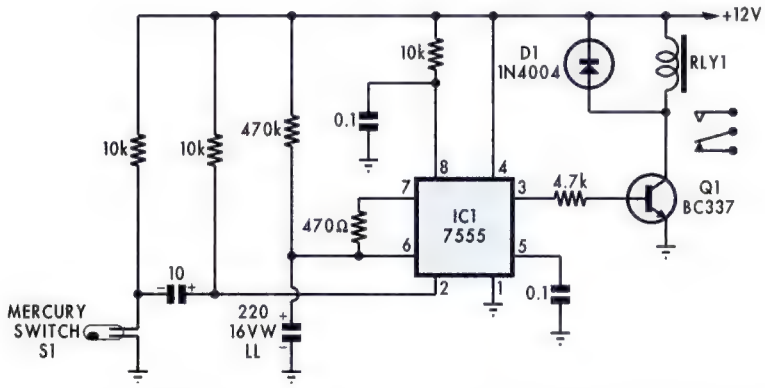
The 1.5kΩ and 1kΩ resistors at the input provide the necessary attenuation of the signal to prevent clipping within IC2. IC1 is simply used to buffer the signal and drive the 150Ω input impedance at pin 4. The 470Ω resistor in IC1's feedback path increases the impedance seen by the op amp to 600Ω to prevent distortion.

The signal output at pin 2 of IC2 is AC-coupled to buffer amplifier IC3a. By virtue of feedback action, pin 2 of IC3a applies signal to the pin 7 input of IC2 where it is rectified and filtered to determine the gain. VR1 sets the output level.

SILICON CHIP.

Bilge pump timer uses a mercury switch

This circuit was designed to enable a mercury switch to replace the contacts in a float switch for a bilge pump. The mercury switch can be expected to last indefinitely compared with the limited life of mechanical contacts in a float switch. However, the mercury switch cannot be used to control the pump directly. Therefore it is used to initiate a 2-minute timer based on a 7555.



The mercury switch is mounted on the float switch lever in such a way that it closes when the water reaches a preset level. This momentarily pulls the trigger input (pin 2) low to start the timer. This takes pin 3 high to turn on transistor Q1 which drives the relay. After two minutes or so, as determined by the 470kΩ resistor and 220µF capacitor at pin 6, the output at pin 3 will go low and Q1 will turn off. The relay must have adequate ratings to handle the current drawn by the pump.

If you need a longer pumping time, increase the value of the 470kΩ resistor and vice versa.

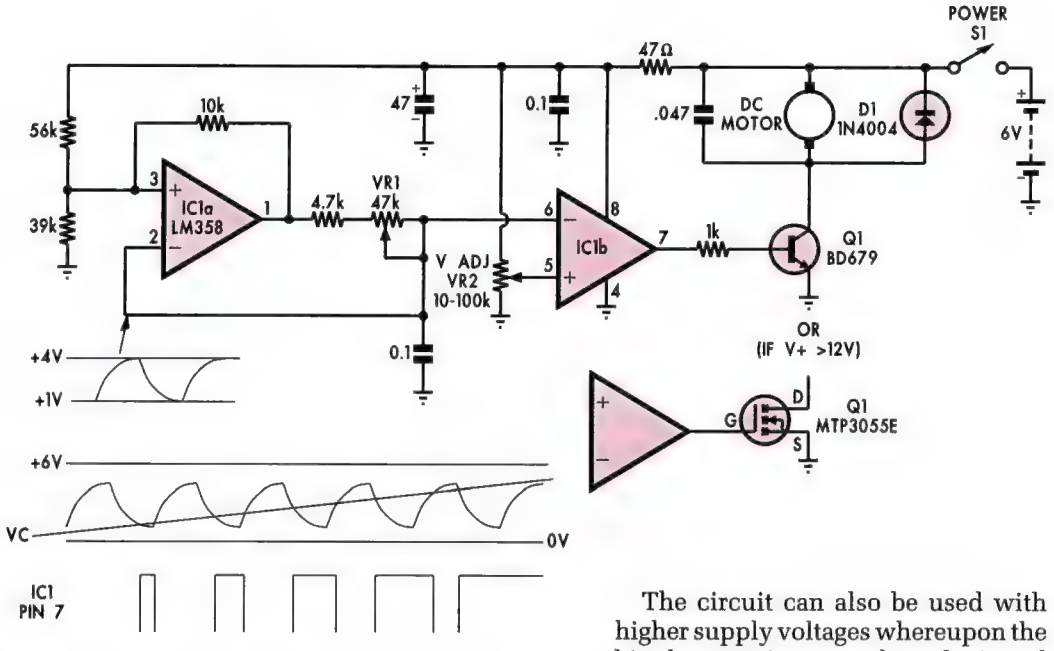
SILICON CHIP.

PWM speed controller

This circuit can be used to provide a wide range of speed control for a 6V DC motor, with very little power dissipation in the controlling transistor.

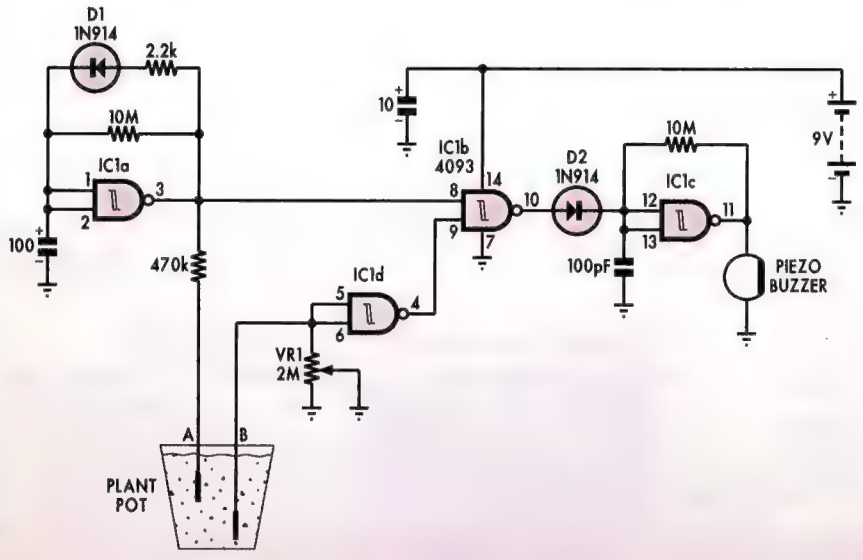
Op amp IC1a forms a Schmitt trigger oscillator with a 45% duty cycle, as set by the voltage divider resistors at pin 3. The frequency is varied between 47Hz and 500Hz by VR1. The waveform at pin 6 of IC1b is a sawtooth and this is compared with the DC threshold voltage set by VR2 at pin 5. With VR2 set for a low voltage, IC1b delivers short pulses; for a high setting, long pulses are delivered.

IC1b drives a Darlington transistor (Q1) to switch the motor. Diode D1 clips the back EMF, while the .047µF capacitor helps suppress EMI from the motor's brushes.



The circuit can also be used with higher supply voltages whereupon the bipolar transistor can be substituted with a Mosfet such as an MTP-3055E or BUZ71.

M. Schmidt,
Edgewater, WA. ($30)



Moisture monitor for pot plants

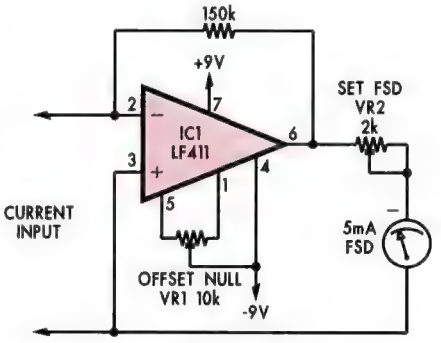
This circuit will sound a piezo beeper when your plants need a drink.

IC1a is a free-running Schmitt trigger oscillator which produces a brief positive pulse once every three minutes. This is fed to pin 8 of IC1b and to pins 5 & 6 of IC1d via a 470kΩ resistor and the pot-plant pot. IC1d is connected to invert the pulses fed to pin 9 of IC1b. This gate's output remains high and inhibits an oscillator comprising IC1c, as long as the soil is moist and conducts.

When the soil is dry, IC1d's output goes high so that IC1b enables IC1c and the beeper sounds. VR1 acts as a sensitivity control.

B. Avi,
Rose Bay, NSW. ($30)

DC amplifier for a centre-zero meter



This circuit will allow a 5mA FSD centre-zero meter to be used where a 50µA meter movement would otherwise be required.

The circuit is based on an LF411 op amp which has been specified for its low drift. It operates as a current amplifier. VR1 is used to zero the meter when the input signal is zero, while VR2 adjusts the full scale deflection.

SILICON CHIP.

Circuit Ideas Wanted

Do you have a good circuit idea? If so, sketch it out, write a brief description & send it to us. Provided your idea is original, we'll publish it & you'll make some money. Send your idea to: Silicon Chip Publications, PO Box 139, Collaroy, 2097.

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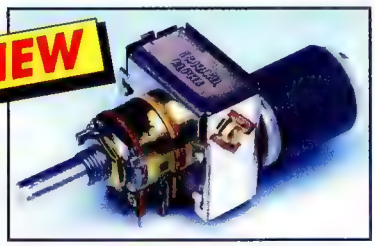

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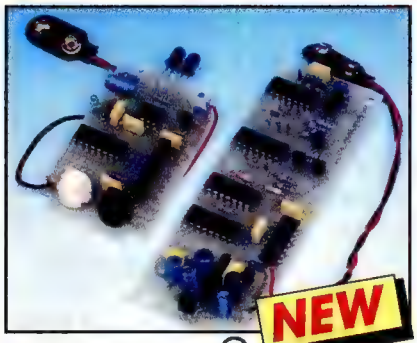

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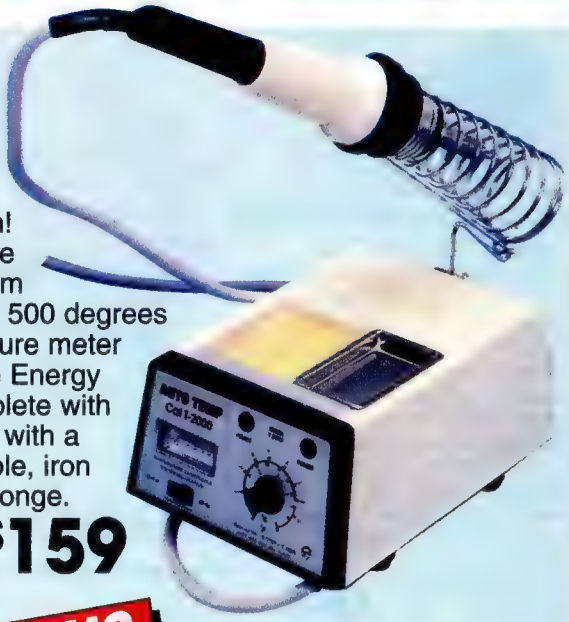

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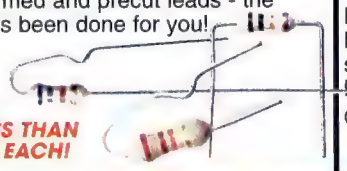

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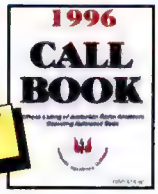

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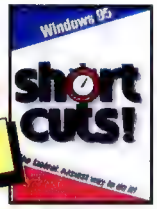

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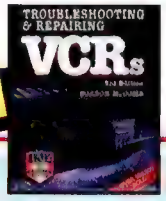

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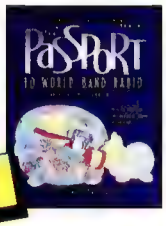

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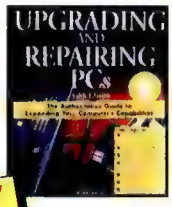

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B 2209

Surround Sound MIXER & DECODER

PART 1 – By JOHN CLARKE

Build this unit and add depth, realism and effects to your home videos. It provides realistic surround sound mixing, while an inbuilt decoder provides the rear channel signal during playback if a surround sound processor is unavailable.

WHILE HOME VIDEOS usually provide fairly bland viewing for all but a few doting grandparents and close relatives, this does not have to be so. Surround sound can capture the audience so that they become part of the action.

Adding surround sound will add a new dimension to your video recordings. It may even stir you into creating bigger and better movie productions, as you experiment with surround mixing.

As well as surround mixing, this Surround Sound Mixer & Decoder can also be used to mix normal stereo signals; ie, by using just the Left and Right channels. You can also mix in signals from two other sources via the A and B channels.

By adding the Centre and Surround channels, you will have surround processing. Signals from the A and B inputs can be mixed into any of the Left, Centre, Right and Surround channels using the L-R and the C-S pan controls. The resulting surround sound signal is encoded into the Left and Right channels and is subsequently decoded on replay.

To simplify the task of mixing, signal level meters are fitted to all four output (L, C, R & S) channels. They comprise 10-LED displays with a -24dB to +3dB range in 3dB steps. In operation, they monitor the encoded Left and Right channel signals and the Centre and Surround channels.

Main Features

- Surround sound encoding and decoding.
- Encoding similar to 4-channel Dolby® surround format.
- Encoded signals can be decoded by Dolby Pro Logic® and passive surround sound units, or by using the internal decoder in the mixer.
- Compatible with normal stereo and mono outputs.
- Separate Left, Centre, Right and Surround inputs, plus A and B channel inputs.
- A-channel panning between L-R and C-S.
- B-channel panning between L-R and C-S.
- Separate level controls for all inputs.
- Balanced or unbalanced microphone and line input options.
- Single output level control.
- LED level meters for the L, C, R & S channels (-24dB to +3dB).

Surround sound playback

The encoded signals can be played back in stereo or mono but in order to obtain surround sound, they must be replayed through a stereo VCR and decoder. While the mixer does incorporate a simple decoder, its main purpose is to provide the meter signals.

Ideally, for best sound effects, the L & R outputs from the VCR should be fed through a Dolby Pro Logic surround sound decoder. This could be a commercial unit or you could use either of the two units described in SILICON CHIP (see Dec.94-Jan.95 and Nov.95-Dec.95). Fig.1(a) shows the basic scheme.

If you don't have a Dolby Pro Logic decoder, the basic decoder built into the Surround Sound Mixer & Decoder can be used instead. In this case, the L & R outputs from the VCR connect to the Left

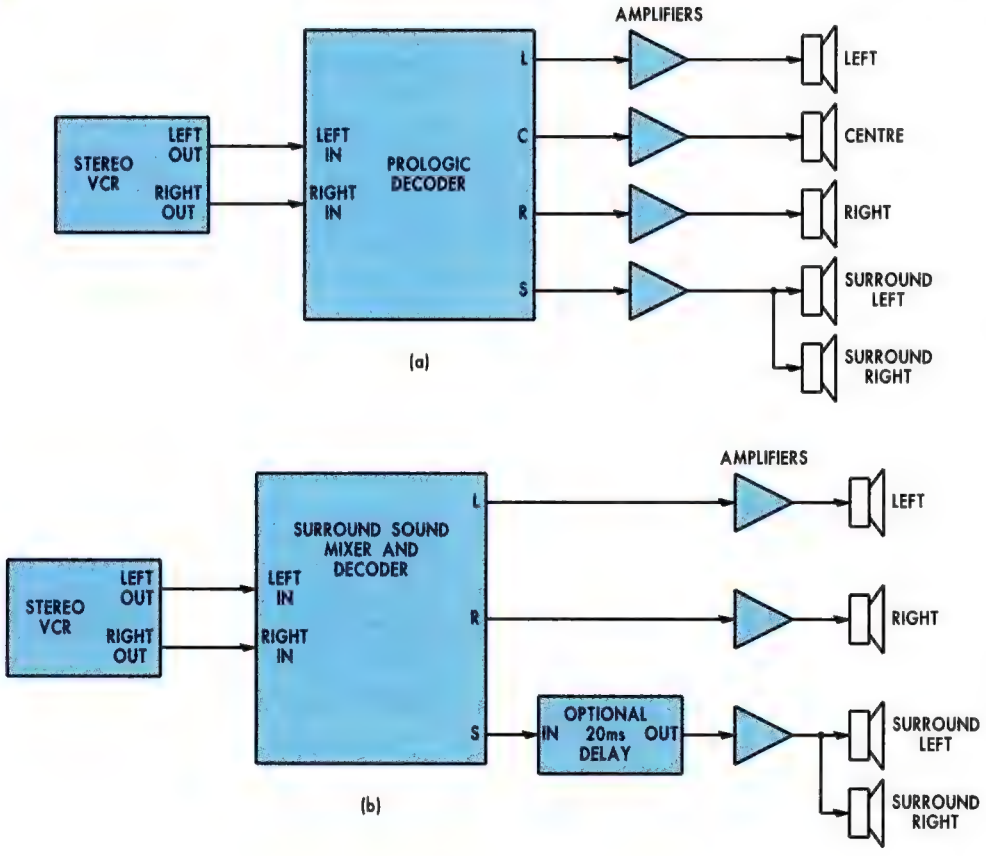


Fig.1: the encoded signals on the video tape can either be decoded using a Dolby Pro Logic unit as shown at (a), or fed through an internal decoder in the mixer itself as shown at (b). In the case of (b), the Centre (C) channel is not normally used, while the Surround (S) channel should ideally pass through a 20ms delay before being fed to its power amplifier.

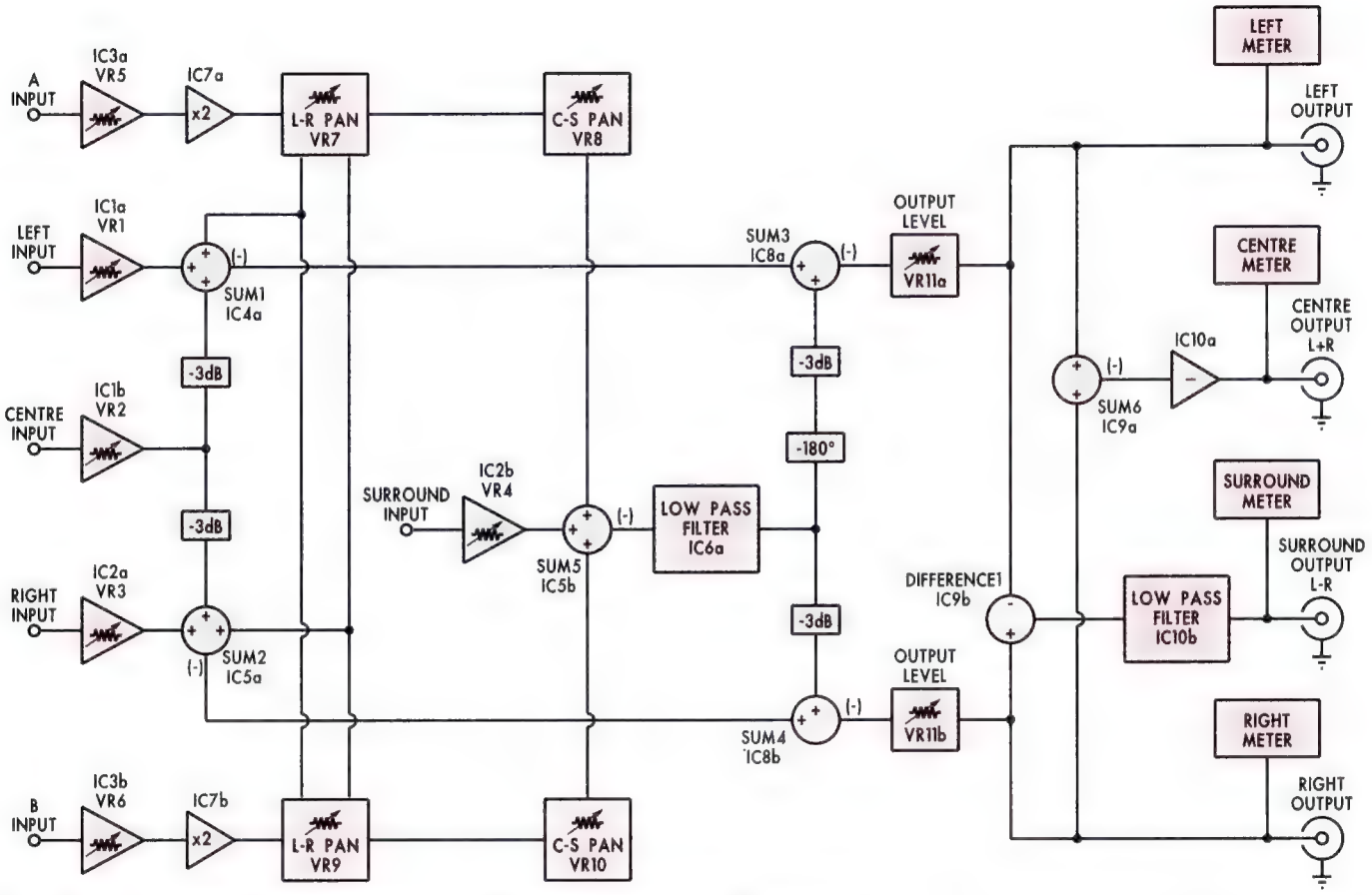


Fig.2: block diagram of the Surround Sound Mixer and Decoder. The various inputs are mixed in summing amplifier stages before being fed to the Left and Right outputs via level controls VR11a and VR11b. On playback, IC9a sums the Left and Right channels to provide the Centre output, while IC9b produces a difference output which is then filtered to provide the Surround output.

and Right channel inputs of the unit in the line mode – see Fig.1(b). The overall volume can then be controlled by the Output Level control, while the balance is adjustable using the individual Left and Right level pots.

Note that, ideally, the Surround channel output from the mixer unit should be passed through a 20ms delay (a suitable 20ms delay unit will be described in the February 1996 issue of SILICON CHIP). The Centre output is best left disconnected here, since it will have poor separation from the Left and Right channels.

Note also that the decoded sound will be nowhere near as realistic as from a Dolby Pro Logic unit. The decoder built into the mixer is very much a "poor man's" approach to surround sound, although it can still give good effects.

In either case, separate amplifiers are required for the Left, Right, Surround and Centre channels in order to drive the loudspeakers. The Left and Right channels are normally fed to an existing stereo amplifier, while a second stereo amplifier can be used for the Surround and Centre channels. Alternatively, some Dolby Pro Logic decoders have several audio amplifiers built in.

Inputs & outputs

As shown on the main circuit diagram (Fig.3), each input has a stereo jack socket which can accept either a microphone or a line level signal, as selected by a toggle switch. Either a balanced or an unbalanced source can be used for the microphone input, while line level inputs must be unbalanced. If necessary, unbalancing can be achieved by using either a mono plug or a stereo plug wired with the ring connection to ground.

At the other end, the outputs are run to RCA sockets to provide the Left, Centre, Right and Surround (L, C, R & S) signals. For recording purposes, the Left and Right channels only connect to the tape recorder (or VCR).

Although making a stereo recording is fairly straightforward, 4-channel recordings will require a fair degree of practice. Fairly obviously, you will need four microphones – one for each channel. For a concert, the Left, Centre and Right microphones should be spread across the stage. The rear channel microphone can either be placed behind the stage or within the audience, depending on the effect you want.

The A and B inputs can be used to add background sounds or music to one or more channels. And, if desired, you can produce the effect of movement between one channel and another by panning. There are four panning controls in all (two for the A input and two for the B input) and these provide panning between the Left and Right channels (Pan L-R) and between the Centre and Surround channels (Pan C-S).

Block diagram

Fig.2 shows the block diagram of the unit. Starting at the left, there are six amplifiers for the Left, Centre, Right, Surround, A and B inputs. The

output levels from these stages are set by potentiometers VR1-VR6 respectively.

The Left amplifier output connects to summing junction SUM1 which comprises IC4a. This mixes in the Centre amplifier output after it has been attenuated by 3dB. Similarly, the Right amplifier output connects to summing junction SUM2 (formed by IC5a) and this also mixes in a -3dB Centre signal.

The A and B amplifier outputs are each amplified by two, using IC7a and IC7b respectively. This is done to compensate for losses in the following L-R pan circuit stages. The resulting L-R pan signals are then mixed into the SUM1 and SUM2 junctions.

Similarly, the Surround amplifier output is summed at SUM5 with the C-S (Centre to Surround) pan control outputs. The summed output is then filtered using low-pass filter stage IC6a, so that only signals below about 7kHz are fed to the following stages.

Following IC6a, the Surround signal is fed in two different directions. In one direction, it is first phase shifted by 180° (ie, inverted), then attenuated by 3dB and mixed at SUM3 with the signal from SUM1. In the other direction, it is fed straight to a 3dB attenuator (ie, no phase shifting) and then mixed at SUM4 with the signal from SUM2.

The process so far is similar to the encoding process used for Dolby Surround Sound recording, except that no noise reduction is used in the Surround signal path. This lack of noise reduction encoding circuitry is not important in this application, particularly as we wanted to keep costs down.

Output level control

The SUM3 and SUM4 outputs are now fed to output level controls VR11a and VR11b, respectively. These are sections of a dual-ganged pot and are used to adjust the encoded Left and Right channel output levels. From there, the encoded signals are fed to the Left and Right channel output sockets. They are also used to drive the Left and Right signal strength meters.

In addition, the encoded Left and Right channel outputs drive summing circuit SUM6 and difference circuit DIFFERENCE1. The SUM6 output provides the Centre channel and is inverted (IC10a) before being fed to the output socket and to the Centre meter.

PARTS LIST

1 sloping front console cabinet, 170 x 213 x 31 x 82mm
1 PC board, code 02302961, 144 x 194mm
1 PC board, code 02302962, 76 x 105mm
1 PC board, code 02302963, 72 x 82mm
1 self-adhesive front panel label, 166 x 215mm
1 self-adhesive rear panel label, 165 x 78mm
6 10kΩ log pots (VR1-VR6)
4 10kΩ linear pots (VR7-VR10)
1 10kΩ dual ganged pot (VR11)
1 1kΩ horizontal trimpot (VR12)
7 SPDT toggle switches (S1-S7)
6 6.35mm stereo PC board mount switched sockets
1 2 x 2-way PC-mount RCA panel socket (Altronics P0211)
1 DC panel socket (to suit plugpack)
1 12VAC 300mA plugpack
4 knobs with blue insets
2 knobs with red insets
2 knobs with purple insets
3 knobs with black insets
15 cable ties
1 15m length of single shielded cable
1 1.5m length of yellow hook-up wire
1 500mm length of red hook-up wire
1 500mm length of green hook-up wire
1 800mm length of blue hook-up wire
4 9mm tapped spacers
4 6mm untapped spacers
4 3mm dia. x 12mm screws
5 3mm dia. x 6mm screws
1 3mm nut
74 PC stakes
4 11-way pin headers (13mm long pins)

Semiconductors
10 LM833 dual op amps (IC1-IC10)
1 TL071, LF351 single op amp (IC11)
4 LM3915 log. display drivers (IC12-IC15)
1 7812T 3-terminal regulator (REG1)
1 B104 1A bridge rectifier (BR1)
4 BC328 PNP transistors (Q1-Q4)
4 1N914 signal diodes (D1-D4)
40 3mm red LEDs (LED1-40)

Capacitors
1 2200µF 25VW PC electrolytic
1 100µF 16VW PC electrolytic
12 47µF 16VW PC electrolytic
6 10µF 16VW PC electrolytic
20 2.2µF 16VW PC electrolytic
19 0.1µF MKT polyester
2 .0027µF MKT polyester
2 680pF ceramic
6 220pF ceramic
1 180pF ceramic
1 100pF ceramic

Resistors (0.25W, 1%)

4 1MΩ	8 4.7kΩ
4 100kΩ	12 2.2kΩ
19 22kΩ	4 1.2kΩ
4 16kΩ	8 1kΩ
2 20kΩ	4 680Ω
4 13kΩ	6 220Ω
1 12kΩ	4 150Ω
30 10kΩ	5 100Ω
2 8.2kΩ	

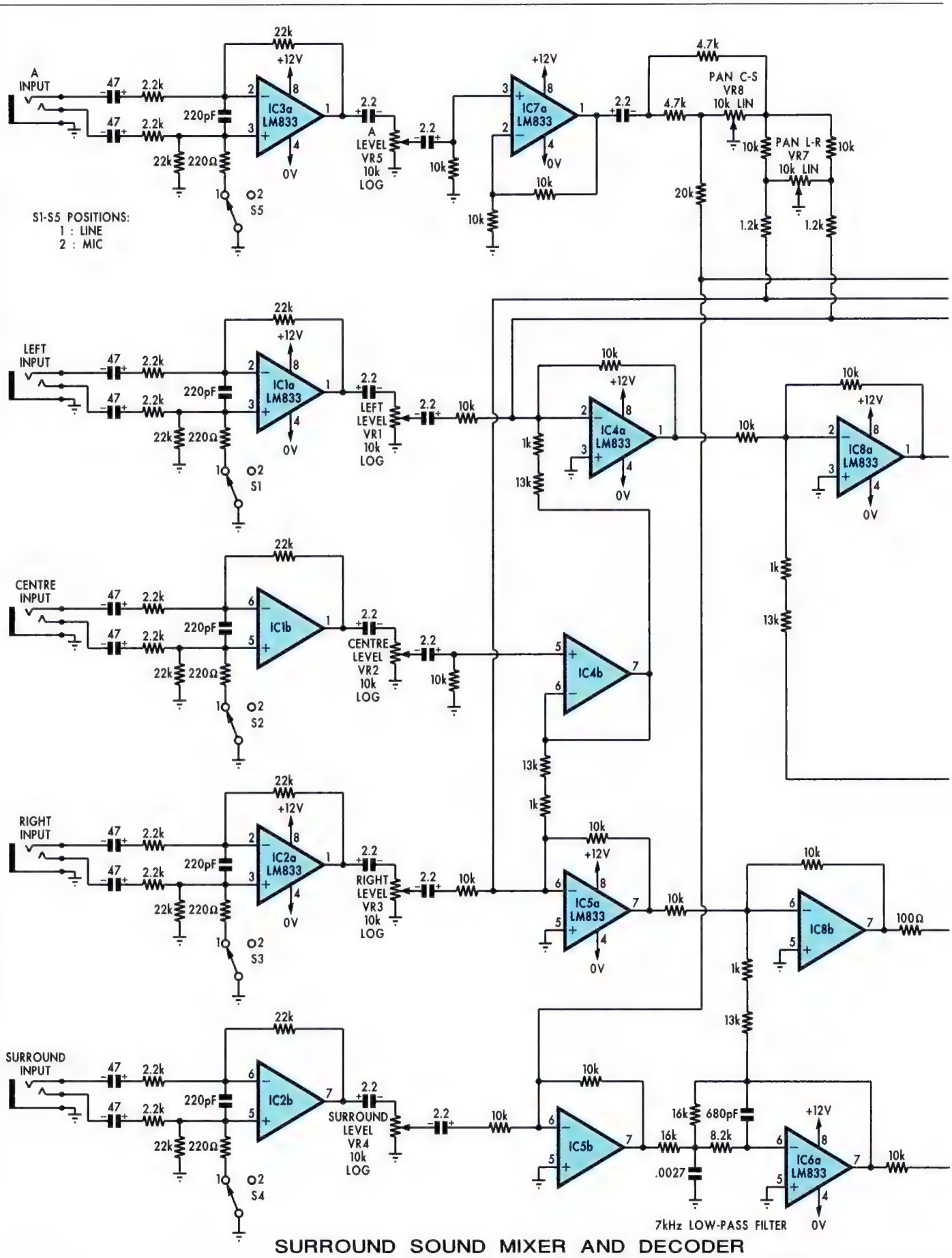
The DIFFERENCE1 output provides the Surround signal. This is rolled off above 7kHz by low pass filter stage IC10b before being applied to the output socket and metering circuitry.

Circuit

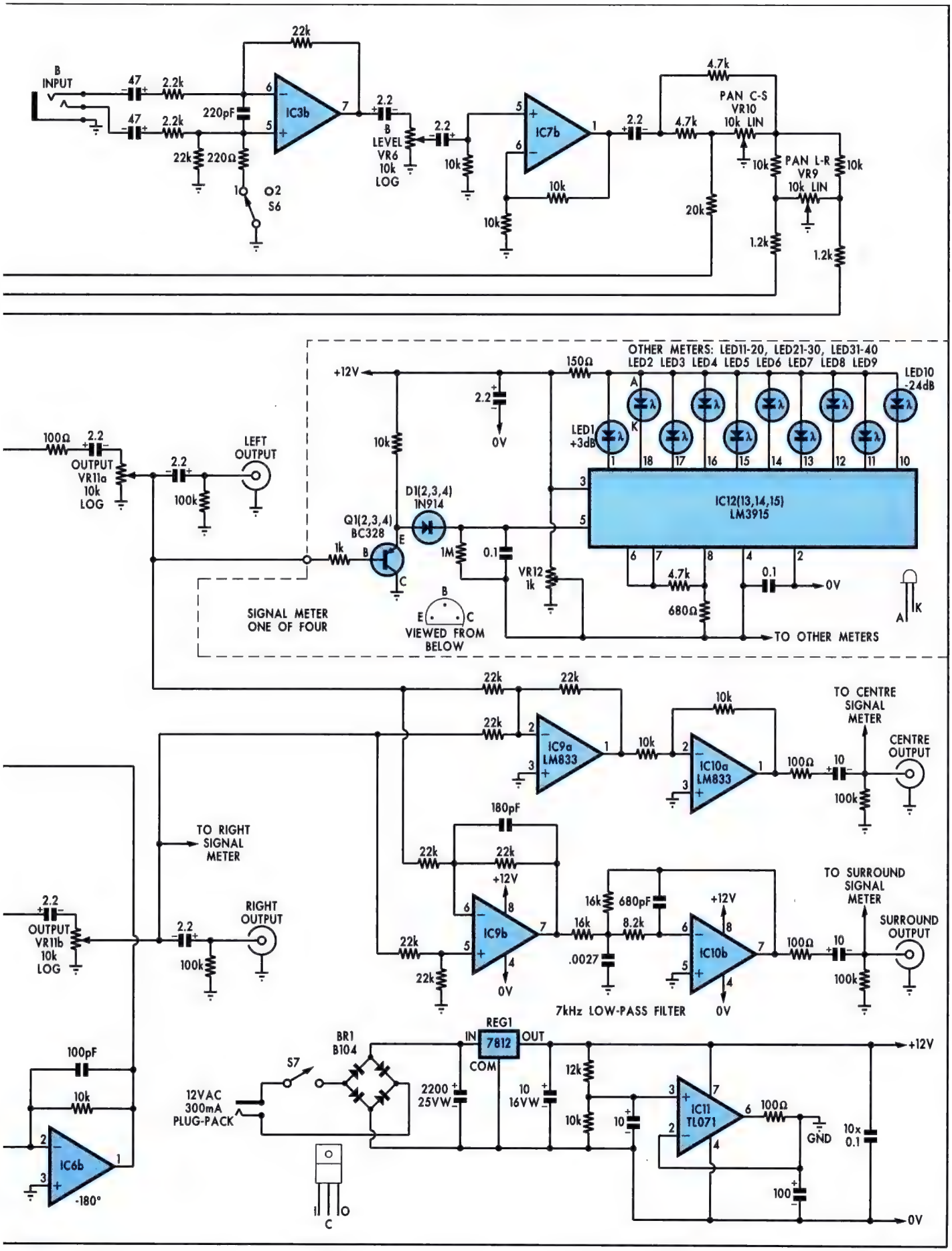
Refer now to Fig.3 for the complete circuit details. Although it may appear quite complicated at first glance, there is in fact a considerable amount of duplication for the various inputs.

Let's begin by taking a look at the input circuitry for the Left signal. This circuit is based on op amp IC1a which is wired in the balanced configura-

Fig.3 (following pages): the input and summing circuitry is based on LM833 dual op amps (IC1-8), and these are also used in the decoding circuitry (IC9-10). IC11 is used to derive the split supply, while the four signal level meters are based on LM3915 display driver ICs.



SURROUND SOUND MIXER AND DECODER


B INPUT
47
2.2k
220pF
IC3b
22k
220Ω
S6
2.2
B LEVEL VR6 10k LOG
IC7b
4.7k
PAN C-S VR10 10k LIN
PAN L-R VR9 10k LIN
20k
1.2k
OTHER METERS: LED11-20, LED21-30, LED31-40
LED2 LED3 LED4 LED5 LED6 LED7 LED8 LED9
LED10 -24dB
LED1 +3dB
IC12(13,14,15) LM3915
+12V
150Ω
100Ω
OUTPUT VR11a 10k LOG
LEFT OUTPUT
100k
D1(2,3,4) 1N914
Q1(2,3,4) BC328
1k
1M
0.1
VR12 1k
680Ω
0V
SIGNAL METER ONE OF FOUR
VIEWED FROM BELOW
TO OTHER METERS
IC9a LM833
IC10a LM833
TO CENTRE SIGNAL METER
CENTRE OUTPUT
180pF
TO RIGHT SIGNAL METER
OUTPUT VR11b 10k LOG
RIGHT OUTPUT
IC9b
16k
680pF
8.2k
.0027
IC10b
TO SURROUND SIGNAL METER
SURROUND OUTPUT
7kHz LOW-PASS FILTER
100pF
IC6b
-180°
BR1 B104
S7
12VAC 300mA PLUG-PACK
REG1
7812
IN
OUT
COM
2200 25VW
10 16VW
12k
IC11 TL071
GND
10x 0.1
100

Performance of Prototype

Signal-To-Noise Ratio
Better than 84dB with respect to 1V output

Frequency Response:
L, C, & R Channels: -1dB at 10Hz & 40kHz
A & B Channels: -3dB at 40Hz & -1dB at 40kHz
S Channel: -3dB at 7kHz

Total Harmonic Distortion
0.01% at 1kHz and 300mV input

Decoder Separation
Surround to Centre Channels: 42dB minimum at 1kHz
Left to Right Channels: 76dB at 1kHz
Left & Right to Centre Channel: 12dB
Left & Right to Surround Channel: 15dB

Signal Handling
2V RMS maximum for line input

Sensitivity:
Mic Input: 30mV for 300mV out. Line Input: 300mV for 300mV out.

tion. Assuming that S1 is in the MIC position, it has a gain of -10 for signals fed to its inverting input and +11 for signals fed to its non-inverting input (as set by the 22kΩ feedback resistor and the 2.2kΩ input resistors).

However, signals applied to the non-inverting input are first attenuated by 0.909 using a resistive divider (2.2kΩ & 22kΩ) before being amplified. As a result, the overall stage gain for signals applied to the non-inverting input is +10, which matches the gain for the inverting input. This gives good common mode rejection for balanced signals (eg, from a microphone).

For unbalanced signals, the inverting socket connection must be grounded externally by a mono plug (or by earthing the ring terminal of a stereo plug). This means that only signals at the socket tip will be amplified, with IC1a now operating as a non-inverting amplifier.

Assuming that S1 is closed (LINE), the input signal is attenuated by the 220Ω resistor and the overall stage gain is +1. The output from IC1a appears at pin 1 and is fed to level control VR1.

IC1b, IC2a, IC2b, IC3a & IC3b are the input amplifiers for the Centre, Right, Surround, A and B channel inputs respectively. These stages are all identical to IC1a and their outputs feed level controls VR2-VR6.

Following VR1, the Left signal is fed to summing amplifier IC4a via a 10kΩ resistor. Similarly, the Right signal is fed via a 10kΩ resistor to summing amplifier IC5a. The Centre channel output at the wiper of VR2 is buffered using IC4b before being applied to each of these summing junctions via a 14kΩ resistance (made up of 13kΩ and 1kΩ resistors in series).

This arrangement effectively attenuates the Centre channel signal by 3dB with respect to the Left and Right signals. That's because IC4a & IC5a operate with a gain of -1 for the Left and Right signals, and a gain of -0.714 for the Centre signal.

Moving now to the Surround channel, the signal on the wiper of VR4 is coupled to pin 6 of IC5b, where it is summed with the Centre-Surround (C-S) pan signals (more on these shortly). The output of IC5b then drives IC6a. This op amp is wired as a 2-pole low-pass filter stage and rolls off frequencies above 7kHz.

TABLE 1: RESISTOR COLOUR CODES

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	4	1MΩ	brown black green brown	brown black black yellow brown
❑	4	100kΩ	brown black yellow brown	brown black black orange brown
❑	19	22kΩ	red red orange brown	red red black red brown
❑	4	16kΩ	brown blue orange brown	brown blue black red brown
❑	2	20kΩ	red black orange brown	red black black red brown
❑	4	13kΩ	brown orange orange brown	brown orange black red brown
❑	1	12kΩ	brown red orange brown	brown red black red brown
❑	30	10kΩ	brown black orange brown	brown black black red brown
❑	2	8.2kΩ	grey red red brown	grey red black brown brown
❑	8	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	12	2.2kΩ	red red red brown	red red black brown brown
❑	4	1.2kΩ	brown red red brown	brown red black brown brown
❑	8	1kΩ	brown black red brown	brown black black brown brown
❑	4	680Ω	blue grey brown brown	blue grey black black brown
❑	6	220Ω	red red brown brown	red red black black brown
❑	4	150Ω	brown green brown brown	brown green black black brown
❑	5	100Ω	brown black brown brown	brown black black black brown

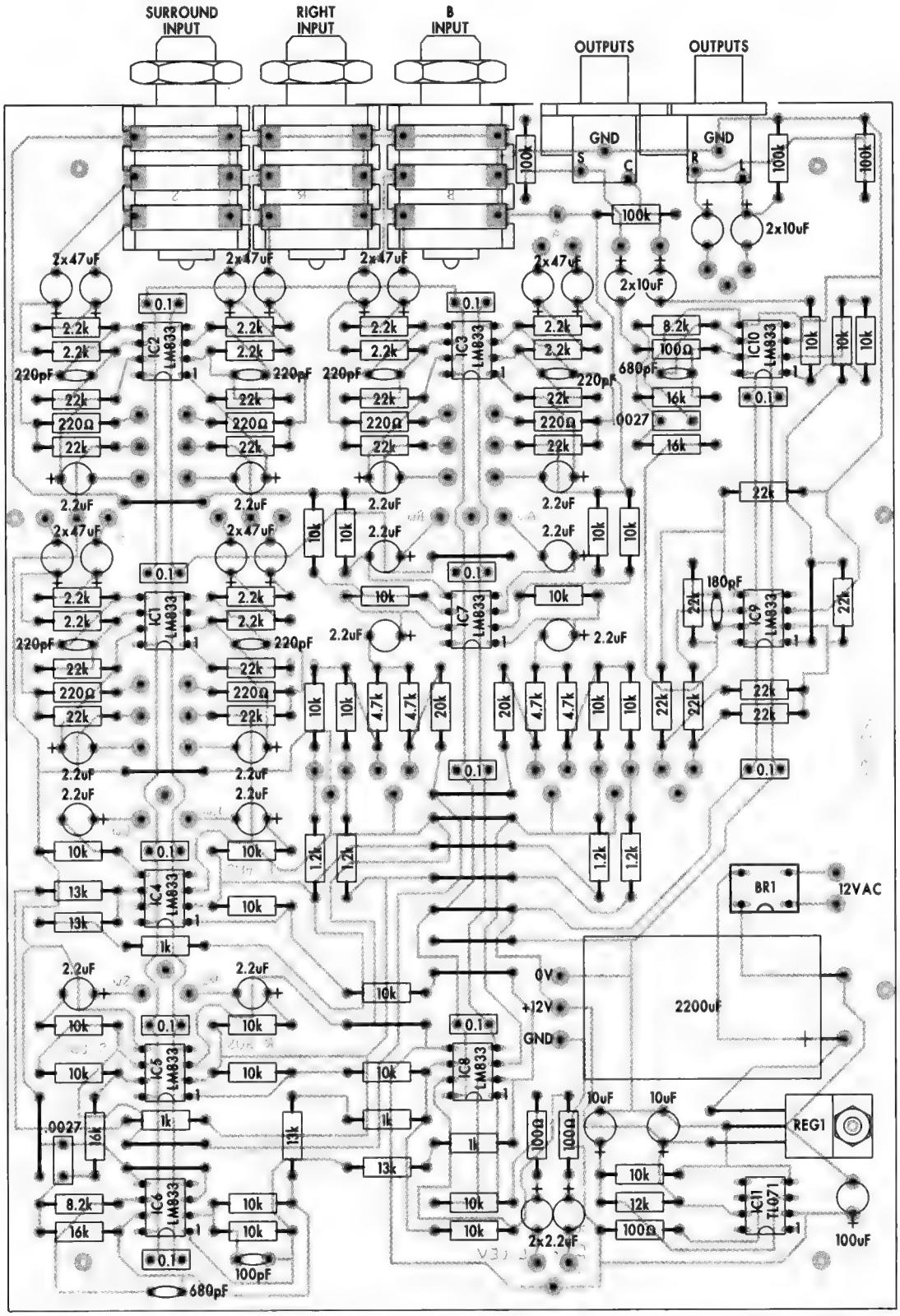
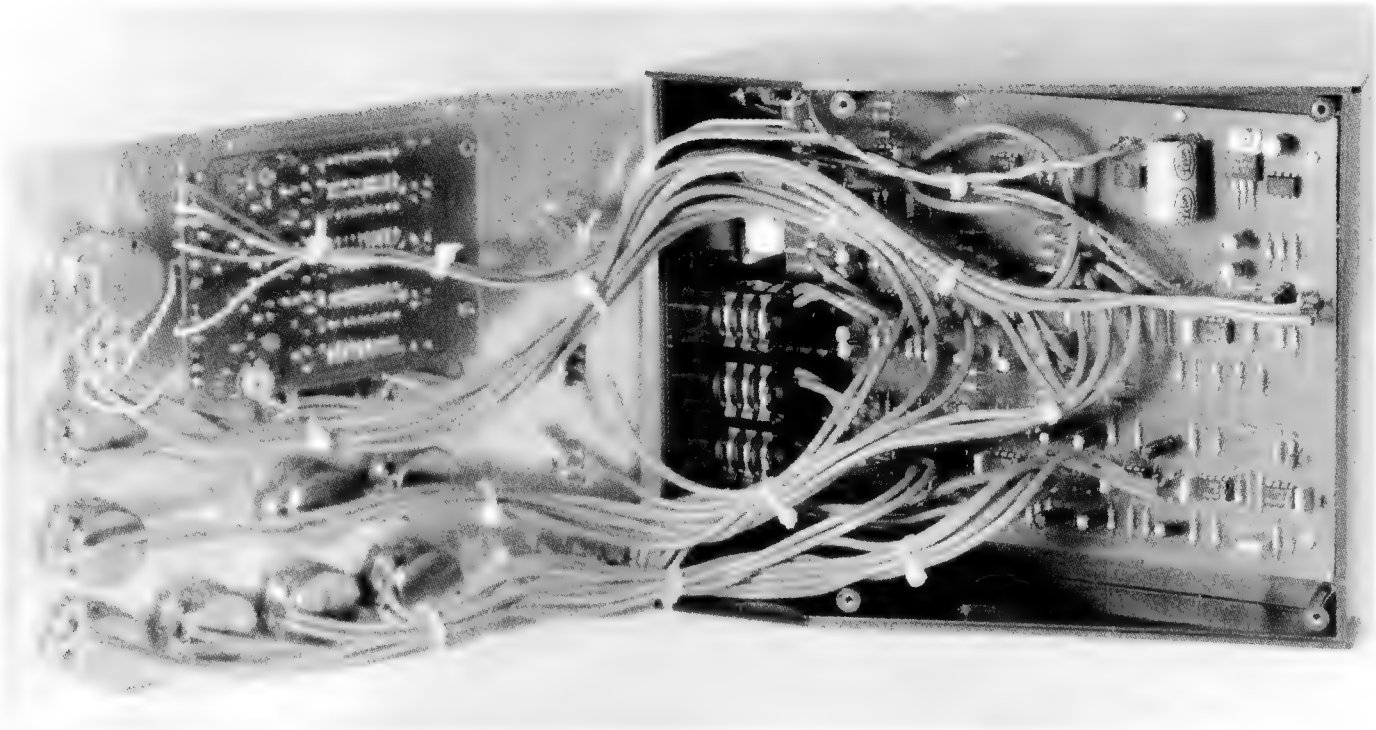


Fig.4: install the parts on the main PC board as shown here. Note particularly that IC11 is a TL071.

The filtered output from IC6a is summed in IC8b with the signal from IC5a. It is also inverted by IC6b (ie, phase shifted by 180°) and summed in IC8a with the signal from IC4a. Note that, in both cases, the filtered Surround signal is attenuated by 3dB in the summing amplifiers due to the 14kΩ input resistances (again made up of 13kΩ and 1kΩ resistors).

Following these two summing amplifiers, the signals are fed to output



The Surround Sound Mixer and Decoder is built into a compact console case with a sloping front panel. Note that there is a fair amount of internal wiring to be run, most of it between the main board and the front panel controls.

level controls VR11a and VR11b. The encoded Left and Right signals are then coupled to their respective output sockets via 2.2µF capacitors.

Panning

Now let's take a look at how the pan signals are derived.

In the case of the A input, the signal at the wiper of VR5 is first buffered and amplified by IC7a. This stage functions as a non-inverting amplifier with a gain of two. The output from IC7a is then applied to pan control VR8 via a 4.7kΩ resistor and to pan control VR7 via a second 4.7kΩ resistor and two 10kΩ isolating resistors.

VR7 is used to pan the "A" signals between the Left and Right channel summing amplifiers (IC4a and IC5a), while VR9 does the same for the "B" signals. Similarly, VR8 and VR10 (Pan C-S) pan the "A" and "B" signals between the Pan L-R controls and the input to IC5b.

In theory, VR7 and VR9 pan between the Left and Right channels, while VR8 and VR10 pan between the Centre and Surround channels. In practice, however, there is some interaction between these controls.

Surround sound decoding

The internal decoding circuitry is based on IC9a, IC9b, IC10a & IC10b and is normally only used on playback – see Fig.1(b). IC9a and IC10a are used to derive the Centre channel. This is achieved by first adding the Left and Right channel outputs together in summing amplifier IC9a. The output of IC9a is then buffered by unity gain inverter IC10a and coupled to the Centre output socket.

A different technique is used to derive the Surround output. In this case, the encoded Left and Right channel outputs are fed to IC9b which is configured as a difference amplifier. This configuration is arrived at by feeding the Left channel to the inverting (pin 6) input and the Right channel to the non-inverting (pin 5) input.

The output from IC9b is simply the difference between the two input signals. This signal is filtered and inverted by low-pass filter stage IC10b and fed to the Surround output socket.

TABLE 2: CAPACITOR CODES

Value	IEC Code	EIA Code
0.1µF	100n	104
.0027µF	2n7	272
680pF	680p	681
220pF	220p	221
180pF	180p	181
100pF	100p	101

Signal meters

As mentioned previously, the circuit contains four signal level meters which monitor the Left, Right, Centre and Surround outputs. These four meters are all identical, so we'll just look at the meter that monitors the Left output.

The circuit is based on IC12 which is a 10-LED display driver wired in dot mode. In operation, the incoming signal is first buffered by emitter follower stage Q1. It is then rectified by D1, filtered and applied to pin 5 of IC12.

The filter components on pin 5 consist of a 0.1µF capacitor and a 1MΩ resistor, connected in parallel. These give the meter a fast attack time and a slow decay response, so the meter effectively displays the peak average value.

As well as acting as a buffer, Q1 also compensates for the voltage drop across D1, since its emitter is always approximately 0.6V above its base. While this compensates fairly well, the balance is not perfect since there is more current through Q1's base-emitter junction than through D1. This slight imbalance is taken care of by using VR12 to set an offset voltage on pin 3 (RLO) of IC12. This jacks the pin

3 voltage up so that it equals the voltage at pin 5 when the input signal is tied to ground.

The full scale deflection value for the meter depends on the voltage on pin 7 and is set by the 4.7kΩ and 680Ω resistors. In this case, the voltage on pin 7 is set to 1.64V, which corresponds to a peak value of 3dB above 774mV RMS (ie, LEDs 1-10 lit). As a result, the meter is calibrated for 0dBm, which corresponds to 1mW into 600Ω.

Power supply

Power for the circuit is derived from a 12VAC plugpack. This is fullwave rectified using BR1, filtered by a 2200µF capacitor and applied to REG1 to derive a regulated +12V output.

IC11 is used to provide the circuit ground, so that the op amps are effectively fed from split supply rails. It does this by buffering the 5.45V output from a voltage divider (12kΩ & 10kΩ) wired across the regulator output. The 100Ω resistor at IC11's output isolates the op amp from the following 100µF capacitive load and prevents oscillation.

As a result, the +12V rail is 6.55V above ground, while the 0V rail is 5.45V below ground; ie we effectively have split supply rails of +6.55V and -5.45V.

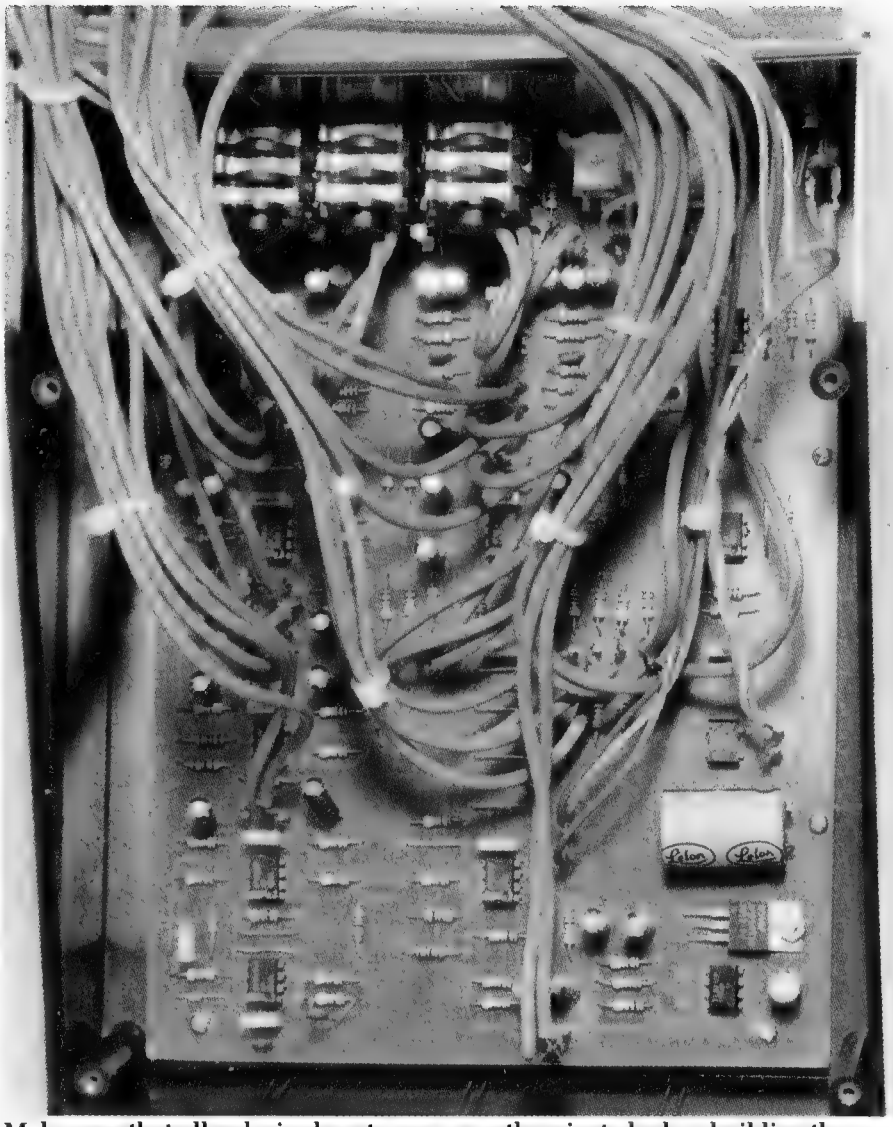
Construction

Despite the circuit complexity, building this unit is quite straightforward. Most of the circuitry is contained on three PC boards: (1) a main board coded 02302961 (144 x 194mm); (2) a display driver board coded 02302962 (76 x 105mm); and (3) a LED display board coded 02302963 (72 x 82mm).

Begin the construction by checking the PC boards. In particular, check for any breaks in the tracks and for shorts between adjacent tracks. The board mounting holes should all be drilled to 3mm, while a 3mm hole is also required on the main board for the regulator (REG1) mounting screw.

Fig.4 shows the parts layout on the main PC board. Start by installing PC stakes at all external wiring points, then install the wire links (using tinned copper wire).

The next step is to install the ICs. Note that these must all be oriented in the same direction. Note too that IC11 is a TL071 while the rest are all LM833s, so don't get them mixed up. The bridge rectifier (BR1) can also now be installed (orient it as shown), followed by 3-terminal regulator REG1. Secure REG1's metal tab to the PC board using a screw and nut.



Make sure that all polarised parts are correctly oriented when building the main PC board. The 2200µF capacitor (bottom, right) is installed on its side and is secured to the board using silicone sealant to prevent lead breakage.

The resistors and capacitors can now be mounted. Table 1 lists the resistor colour codes but it is also a good idea to check them with a multimeter, as some colours can be difficult to decipher. Table 2 lists the capacitor codes. Make sure that the electrolytic capacitors are all correctly oriented and note that the 2200µF capacitor is mounted on its side.

Use silicone sealant to secure the body of the 2200µF capacitor to the board, to prevent its leads from flexing and eventually breaking.

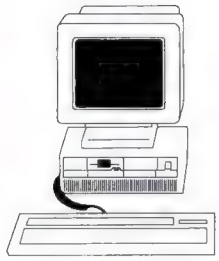
As shown on Fig.4, three of the 6.35mm stereo sockets are mounted directly on the main board. Install these now, along with the 2 x 2 RCA socket package. The mounting clips on the underside of RCA socket package will have to be removed using side cutters before it is installed on the board.

That's all we have space for this month. Next month, we will resume with the parts layout diagrams for the display driver and display boards and give the complete wiring and testing details. We will also publish the full-size PC board patterns and the front-panel layout.

Note: "Dolby", "Pro Logic" and the Double-D symbol are trademarks of Dolby Laboratories Licensing Corporation, San Francisco, CA 94103-4813 USA.

COMPUTER BITS

BY GEOFF COHEN
gcohen@pcug.org.au



Upgrading your old PC – is it worthwhile?

Is it worthwhile upgrading your old PC or should you put the money towards a new one? The answer depends on the state of your old PC and the applications you wish to run.

There are a swags of old 286, 386 and even 486SX PCs floating around now and a question I often get asked is "is it worthwhile upgrading my old PC to run Windows, or should I buy a new one?". The answer depends, of course, on what sort of PC you have and how much you want to increase the performance – and thus how much you are prepared to spend on the upgrade.

The options are: (1) do a minimal upgrade and recycle the old PC so the kids can run Windows (word processing and games); or (2) go for a full upgrade by replacing the motherboard, CPU and hard disc.

Is it worth it?

First, you have to decide if it is worthwhile upgrading your PC. If you have a PC with a mono screen, a hard disc smaller than 80Mb and less than 4Mb of RAM, upgrading the PC to run Windows (especially Windows 95) is not really an economic proposition. In addition, if you have a major brandname PC (IBM, Compaq, etc), you will need to check if the beast uses a standard size motherboard, with normal plug in cards. Many brandname computers use specialised components and cannot accommodate some of the standard parts used in clone PCs.

However, if you your PC has a minimum of a VGA card, a colour monitor and at least 4Mb of RAM, it may be worthwhile upgrading it. At the time of writing (November 1995), the cost of upgrading to a 486DX2-66 motherboard (including the CPU) is around $300.00, while a 545Mb hard disc drive and controller can be had for just $280.00.

The cost of RAM is not too bad either, with the price of a 4Mb 72-pin RAM module currently around $230.

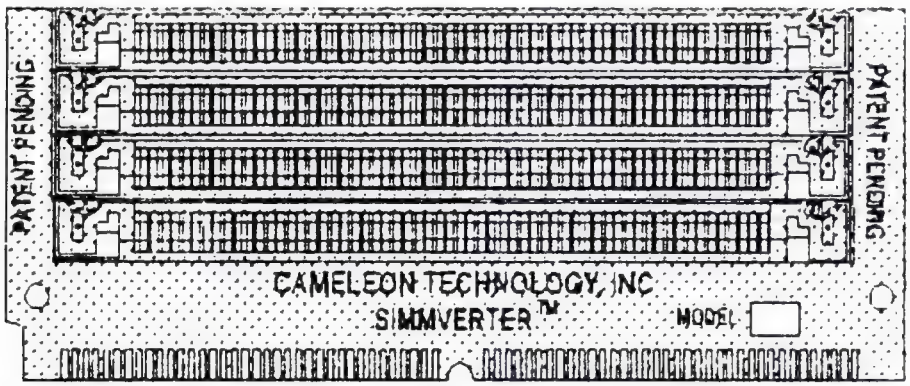


Fig.1: the SimmVerter from Cameleon Technology accepts four 30-pin memory modules (either 4 x 1Mb or 4 x 4Mb) and effectively converts them to a single 4Mb or 16Mb 72-pin memory module that plugs into the latest motherboards.

What should I upgrade to?

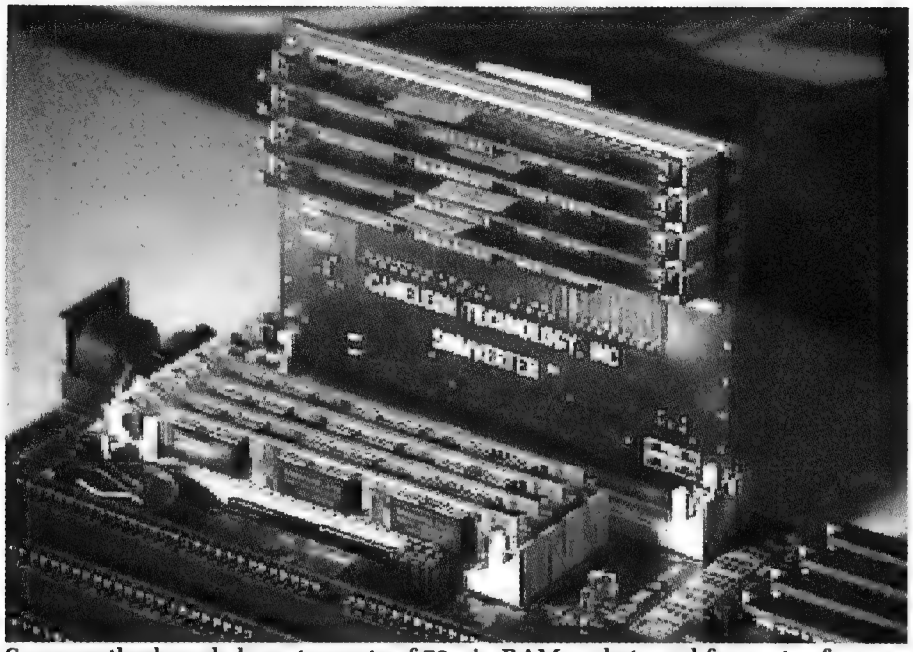
The answer to this question depends on what you want to do. Here are a couple of alternatives to consider:

(1) Windows/games PC. If you only want to run Windows 3.1 at a reasonable speed – eg, so that the kids can run Word and a few games – I would recommend upgrading to:
(i) a 486DX2-66 CPU (these are so cheap it's not worthwhile using a slower CPU);
(ii) 4Mb RAM; and
(iii) an 80Mb or preferably bigger hard disc.

(2) Microsoft Office/Windows 95 PC. These programs require a bit more firepower than the system listed above. To run Microsoft Office the minimum system would be:
(i) a 486DX2-66 or 486DX4-100/120 CPU, a Pentium being even better;
(ii) 8Mb RAM for Windows 3.1 or 16Mb for Windows 95;
(iii) a 540Mb, 850Mb or even a 1Gb hard disc.

In addition, a CD ROM drive is handy for installing programs like Office and Windows 95 , as it saves having to install from multiple floppies.

I have noticed that there are still suppliers advertising Windows 95 systems with only 8Mb of RAM. I have tried this and it is very slow with Office 95. In fact, you need at least



Some motherboards have two sets of 72-pin RAM sockets and four sets of 30-pin sockets. This photo shows a SimmVerter module, itself carrying four 30-pin SIMMs, plugged into one of the 72-pin sockets at the rear.

16Mb for a Windows 95 system if it is to operate at a reasonable speed.

Using your old memory

A major problem used to be that while older motherboards used 30-pin SIMM RAM, the latest 486 and Pentium motherboards only have sockets for the new 72-pin SIMM RAM. This meant that upgrading to a new motherboard with 72-pin sockets necessitated throwing out (or selling cheaply) any existing 30-pin RAM, which was a tad annoying.

Fortunately, a new device in now available which overcomes this problem. It's called a "SimmVerter" and it effectively allows four 30-pin SIMMs (1Mb or 4Mb) to be converted to one 4Mb or 16Mb 72-pin SIMM module. All you have to do is plug four 30-pin SIMMs into the sockets on the SimmVerter. The SimmVerter itself then plugs into a 72-pin RAM socket on the motherboard.

SimmVerters cost around $30 each, which is far less than the cost of having to replace 4Mb of RAM. They are available in four different shapes so that you can easily accommodate four SimmVerter modules adjacent to each other, if necessary – see Fig.2.

Another approach is to see if there is any secondhand RAM available, either on the Net (eg, aus.ads.forsale.computers) or in the Saturday paper. An important difference with the Pentium is the need to fit 72-pin SIMMs in groups of two. I won't mention who fell for that trap the first time he installed a Pentium motherboard and used a single 8Mb SIMM, instead of two 4Mb SIMMs, and then complained that the !@#$%^&* thing wouldn't work.

If you want to improve Windows performance, the cheapest option is to increase your RAM. Upgrading from 4Mb to 8Mb makes the biggest difference and Word 6, for example, loads many times faster with this simple upgrade. Increasing the memory even further will provide even better performance and allow more programs to be opened. 16Mb is a good size for Windows 3.1 and 32Mb for Windows 95.

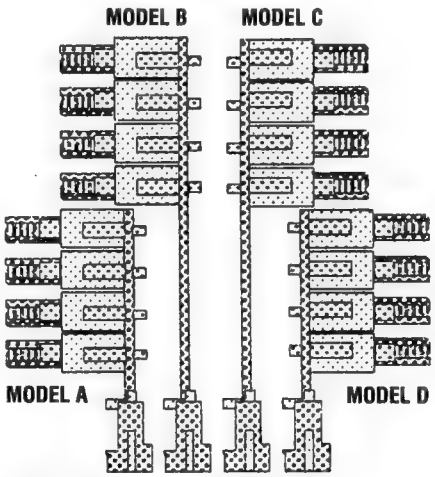


Fig.2: SimmVerters come in four models (A, B, C and D) so that they can be fitted to adjacent memory sockets.

Parity or non-parity RAM

Most new motherboards have a CMOS option to enable or disable parity RAM, the default option being non parity in the motherboards I have tried. Unless the PC is going to be used as a network server, non parity RAM should be adequate, as a RAM test is performed every time the PC is switched on. In any case, I cannot remember the last time I had a faulty RAM chip – it was, at least, several years ago.

Disc controllers

An upgraded disc controller card may be necessary if you are upgrading the hard disc. Assuming that you are going to stick with an IDE disc, you can purchase a multi-I/O card for around $25. As well as running your floppy drives and two IDE hard discs, this will also generally provide two serial ports, a parallel printer port and a games port. If you have (or are upgrading to) a VESA motherboard, then you should buy a VESA multi-I/O card, as they are much faster than a standard ISA card.

Note, however, that most new Pentium PCI motherboards will already have the floppy, hard disc and I/O controllers on board. In that case, you don't have to worry about a separate I/O card.

Hard discs

Depending on your requirements, you could stay with an existing 80-200Mb hard disc and buy a used 100-200Mb drive. However, a new 500Mb hard disc is only around $200 and a minimum of 150Mb is needed to run the full Windows 3.1 and Microsoft Office suite of software.

If you are fitting a hard disc of 500Mb or above and have thousands of files, you need to consider how to partition it. For drives under 512Mb, a one byte file will take 8192 bytes. This increases to 16,384 bytes for 512-1024Mb drives, and so on.

In other words, the larger the logical drive, the larger the space that a one byte file effectively takes up and this wastes space. For example, if you have an 850Mb disc with 10,000 files, this will waste (on average) 10,000 x

The ZIP Drive – 100Mb On A $33 Disc

Most computer users don't consider backing up the large hard discs that are now being sold. There's an old saying that there are only two types of computer users: those who have lost data and those who will lose data. The truth is that backing up onto floppy discs is often too cumbersome, while tape drives have the capacity but are quite slow when it comes to retrieving files (unless you have a DAT tape drive).

External drive

An external drive is the answer to backup problems. One interesting new device is the Zip drive which has recently been released by Iomega. This is a (relatively) cheap 100Mb removable disk drive which retails for around $370, with the 100Mb discs selling for around $99 for a pack of three. When installed, it is assigned a drive letter and is treated just like any other disc drive.

I have been using the parallel port version for several weeks now. It really is quite nifty – you just plug it into a parallel port, run GUEST.EXE and copy to/from the ZIP disc. A SCSI version is also available for the same price and is reported to be three times faster than the parallel version. On the downside, the SCSI version isn't as portable and you have to buy a SCSI controller for it.

Testing

I did some testing and found that large database files copied to the Zip drive at about 4.5Mb per minute. Alternatively, by using Norton Backup and saving to a logical disc drive, I was able to copy at an effective 8-10Mb per minute and fit over 250Mb (before compression) on one 100Mb disc. So, at just $33 per disc, the Zip drive is good for archiving applications.

Assuming that it stands up to prolonged use, the Zip drive is a good product. I tested mine by copying files to and from it for over 20 hours without any problems. Zip drives are imported by PolaroidAustralia (1800 066 021) and are available from computer dealers and from Harvey Norman retail stores.

16,384/2 bytes, or around 80Mb.

However, if this disk was configured into two 425Mb partitions, you would save over 40Mb of space. So consider carefully how you should partition the disc (using FDISK), before you actually start using it.

Video cards

Even with a Pentium processor, the speed at which Windows updates the screen may not be all that fast if an old ISA video card is fitted. Starting at around $120, a VESA or PCI video card will speed things up considerably. Typical examples, using ATPERF for relative performance details, are:

Old ISA	2
VESA	12
PCI	20

Another item to consider, if you want to use high resolution (ie, 1024 x 768 or larger), is the amount of video RAM. A new video card should have a minimum 1Mb of RAM (preferably with sockets to accept more), or you can just bite the bullet and get a video card with 2Mb of RAM for even better performance.

Installation

For timid souls, there are many computer shops and technicians who will upgrade your PC for a reasonable labour cost. If you are more adventurous, replacing a motherboard is a relatively straightforward job.

First, remove all cables from the PC (including the power cord) and remove the cover (this is usually done by removing a number of self-tapping screws). Once inside the PC, remove all the plug-in cards from the motherboard.

Depending on the age of the PC, the motherboard itself will probably be secured by two or more screws that will need to be removed. Once this has been done, the motherboard will then either lift or slide out.

The next step is to swap the nylon clips from the old to the new motherboard, after which the new motherboard can be installed in the case and the plug-in cards reinstalled. An important point to note here is that if you have two connectors that go to the power connector on the motherboard, the black wires should be next to each other when they are plugged in.

Another option that you may want to consider is a new case, especially if the old one is looking a bit tacky. A complete mini-tower case and power supply can be purchased for less than $100 and would certainly improve the value of the PC if you wanted to sell it.

Finally, if you have any problems locating a SimmVerter, I purchased mine from The Logical Approach in Canberra – phone (06) 251 6511. **SC**

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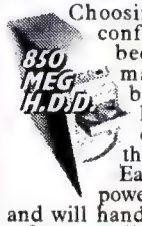

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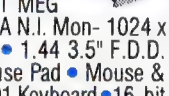

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REMOVABLE CARTRIDGE ZIPPY DRIVES

WITH ACCESS SPEED OF 13.5MS, WHICH IS ALMOST ON PAR WITH TODAY'S HARD DISK DRIVES SPEED, "ZIPPY" ACCESS TO DATA HAVE NEVER BEEN SO QUICK AND EASY! AS FAST ASS A HARD DRIVE.

This is the most powerful and efficient peripheral you can buy to compliment your computer system. **EZ135 Drives** combine the speed and reliability of hard drives to enable you to store and retrieve files lightning fast, with the removability of a floppy to ensure you'll never run out of space.

SYQUEST EZ135 DRIVES-

NEW

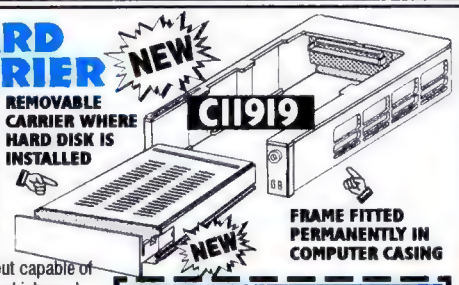
EASY TO USE -SAVE ON THOUSANDS OF FLOPPIES!

SPECIFICATIONS:

Interface: ATA/IDE
Capacity: 135MB (formatted)
Average Seek Time: 13.5msec
Data Transfer Rate:
Burst - 4.0MB/sec
Sustained Max - 2.4MB/sec
Reliability and Maintenance: MTBF - 200,000 hours (P. O. H)
Preventative Maintenance: None
Dimensions: 254 (H) x 101 (W) x 150 (L) mm
Weight: 425gm
Warranty:
Drive - 2 years
Cartridge - 5 years

IDE (Internal) C11878 ..... $399
SCSI II (External) C11876 ..... $449
135MB cartridge C11890
1-9 ....$49 10+ $42.95

REMOVABLE HARD DISK DRIVE CARRIER



A great idea that answers the prayers of many network managers in organisations that are constantly in need of exchanging data between internal departments. Faster even than attempting huge amount of data transfer across network! Simply remove the hard drive carrier holding the required hard drive and then simply insert it into the computer system that needs to access the same data. Very much like the removable cartridge drives system, but capable of holding as much data as the hard drive's capacity- which can be anything from 540mbytes to Gigabytes!

IF YOU ARE CONSTANTLY EXCHANGING HUGE AMOUNT OF DATA BETWEEN COMPUTERS- YOU NEED ONE OF THIS!

IDEAL FOR HOME/WORK OFFICE SITUATIONS

• Data security- simply remove the disk and lock it away • Multiple operating systems • Requires 1 5¼ drive mounting bay • Suitable for IDE hard drives only

NOTE: • Computer must be turned off to insert/remove or change hard disk • System CMOS must be set if using drives with different geometry

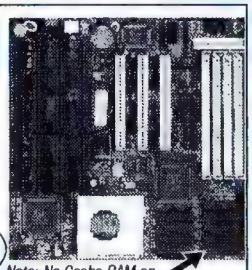
Complete Kit including:
Removable Carrier & Frame...$99
Note: Only available as a complete kit at the moment

PCI/ISA 486 MOTHERBOARD

Support all members of 486 family, and features a WRITE Back/WRITE THROUGH secondary cache memory from 256K in size. Support PCI local bus architecture, ISA bus architecture and integrate a High Performance PCI IDE Controller on-board. Support Dark Green Function (SMM mode of SMI-CPU).

CPU: • Intel 80486SX/DX/DX2/'SL Enhanced 25/33/50/66 MHz • Intel 80486DX4 75/100MHz • AMD486DX/DX2/DX4 40/66/80/ 100MHz • Cyrix Cx486DX/DX2 40/50MHz • UMC U5S 33MHz SIMM module. *System Memory:* • 4 x 72pin SIMM module• flexible memory size from 2MB to 128MB Cache • Support 0/128/256/512KB secondary cache on board with either Write Back or Write through mode. *On-board IDE:* • Support 4 IDE Device and Enhanced IDE Function. *I/O Bus Slots:* • 32-bit PCI Local Bus slot x 3 • 8-bit XT Bus slot x 1 • 16-bit AT Bus slot x 3. *Board Size* - 220 x 220mm

PCI 80486 MOTHERBOARD WITH IDE CONTROLLER BUILT IN



This 80486 motherboard is packed with features found only in Pentium® versions! They include PCI & ISA Local Bus, on-board IDE interface, Zif socket and even green PC power management. Set up is a breeze with the WinBios from American Megatrends Inc. Now you can bring your 486 cpu system up to speed with the rest of them!

X18401 $169

Note: No Cache RAM on board (dummy chips)

SPECIFICATIONS

- Supports CPUs running at 25/33/40/50/66/75/80/100/120 MHz including:
  -Intel P24D, P24T, 80486DX4 (P24C), DX/DX2-SL, DX2/DX/SX
  -Cyrix Cx486DX2/DX/S & M1-SC
  -AMD DX/DX2/4
  -Enhanced AMD DX2/DX4
  -Ti 80486 DX2
  -IBM 80486 DX2
- PCI/Host bridge compliant to PCI specifications
- DRAM auto-detection/banking
- Supports four banks of DRAMS including four 72-pin SIMM sockets with memory size up to 256MB using combinations of 256K, 1M, 2M, 4M, 8M, 16M, 32M, 64M SIMM modules
- Support 4Mx4 4K, 2Mx8 4K, and 1Mx16 2K of refresh DRAM
- Provides Green PC power management
- Three PCI connectors and four 16 bit I/O slots
- Two enhanced IDE interfaces on-board (support ATA spec., up to mode 4, and BUS master)
- Supports two 16550 compatible enhanced serial ports and one floppy disk interface
- Support EPP/ECP high performance parallel port
- Built in NCR SCSI driver

NEW

CPU TO SUIT:
486DX2-66 ..... $69
486DX2-80 ..... $89
486DX4-100 . $129
486DX4-120 . $199

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SCNP196-DEC'95S

LATEST KITS RANGE

-For our complete range of kits see pages 175-184 of our **1995-96 annual catalogue**. If you don't own one, fill in the coupon below and we will send you a free copy. The latest kits project update is also published in our monthly magazine- ***"Communicate!"***. If you are not on our subscription list, just write to us and enclose $12 for one years' subscription.

LOW COST MICRO-BASED ESR & LOW OHMS METER

NEW

K10730 $44.95

If you repair switch-mode supplies, TV receivers, computer monitors, vintage radios, or similar equipment, and/or if you need to measure very low values of resistance, this project can save you lots of time and aggravation. It measures an aspect of electrolytic capacitors performance which is very important, but normally very difficult to check: the equivalent series resistance, or "ESR" *EA JAN '96*

PC DRIVEN EGO SENSOR ANALYSER

K10735 $39.45

NO PICTURE AVAILABLE AT TIME OF PUBLICATION

With car engine managent systems becoming more and more sophiscated (and complex), it is getting increasingly difficult to find out what's happening "under the hood". This low cost analyser, combined with any IBM PC and some special software can provide a large amount of information on your car's performance. *EA JAN'96*

SMART DUAL 12V BATTERY CONTROLLER

K10740 $59.95

NEW

ASSEMBLED & TESTED $99.95

This auxillary battery manager takes full advantage of a dual battery setup's capabilities, by controlling when and how the "auxillary" battery is connected to the electrical system. It's fully automatic, will cost you far less than an equivalent commercial unit, and is particularly suited to the new breed of deep-cycle auxillary batteries *EA JAN'96*

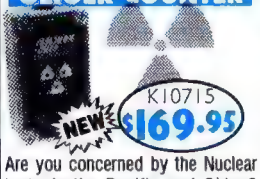
ENGINE IMMOBILSER

K10720 $35.95

NEW

This circuit will immobilise your car if a thief tries to start it. Fit it to your car as cheap insurance. If a thief tries to steal your car, the engine will repeatly stall and he will move to easier pickings. *SC Dec'95*

GEIGER COUNTER



NEW

K10715 $169.95

Are you concerned by the Nuclear tests in the Pacific and China? Worried about a possible increase in the amount of background radiation? Then check it out with this Geiger counter. It will detect alpha, beta and gamma radiation and has an audible output *SC Oct'95*

Geiger Tube available at $119.00

TRIAC TRIGGER

K10167 $109.95

This Triac Trigger can actually switch on or off any 240 mains devices. This kit is a supplement to the I/O adaptor for PC (k10165). Just imagine being able to control almost any mains devices from your computer *EA Feb '89*

SHORT FORM
K10166- $59.95

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$1-$9.95	$3.00	$50-$99.95	$6.00
$10-$24.95	$3.50	$100-$199	$7.00
$25-$49.95	$4.00	$200+	*FREE*

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CLAYTON SOUTH, 3169.

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Phone: ..... Date: .....
❑B/CARD ❑VISA CARD ❑AMEX ❑DINERS TOTAL$.....

Signature: .....Exp. Date:.....

SCMET/96-DEC/95S

FLASHING LED

CHEAP PROTECTION FOR YOUR CAR. EASY TO INSTALL AND WIRE UP.

Flashing 12VDC LED alarm indicator. Small 5mm LED size in bezel housing.
- Hole size: 7mm
- Max panel thickness: 4mm

S15087 $4.95

NEW

ADAPTOR- SCSI TERMINATOR

50 pin IDC single sided internal SCSI terminators • Passive

X15702 $24.95

NEW

AVAILABLE TO ORDER

ADAPTOR-SCSI TERMINATOR

50 pin IDC double sided internal SCSI terminators • Passive

X15104 $39.95

NEW

AVAILABLE TO ORDER

SCSI ADAPTOR

Honda 30 pin plug to DB25 female
• "T" shape

X15706 $69.95

NEW

RIE-ALWAYS AHEAD WITH NEW PRODUCTS

50 WATT AMPLIFIED COMPUTER SPEAKER

Magnetically shielded speakers for monitor, drive an disc protection. Unique styling with space-saving compact size.

OVAL SPEAKER 50 x 90mm

Power Output:	50 watt P.M.P.O.
Frequency resp:	20 - 20K Hz
Speaker Impedance:	4 ohm
Cord length:	6' to source
Power:	on/off
Volume control	
Dimension:	198 (H) x 75 (W) x 95 (D) mm

C10110 $59.95

NOW $49.95

NEW

INDOOR/OUTDOOR SPEAKERS

3-WAY ACCOUSTIC SYSTEM WATER RESISTANT

25 WATTS RMS POWER HANDLING

NEW

3 way speaker system in a water resistant ABS plastic cabinet. Ideal for patios, pergolas and boats or other potentially wet areas. Completely sealed enclosure houses a "4" woofer, midrange and tweeter drivers. Supplied complete with mounting brackets. The speakers are internally set up to be wired as either 4 or 8Ω.

- Speakers: 4" woofer treated paper cone, 2" cone midrange. 1/2" mylar dome tweeter
- Power: 25WRMS
- Impedance: 4 or 8Ω.
- Freq Resp: 100Hz to 16KHz
- Sensitivity: 92dB @ 1mW
- 182 (H) x 113 (W) x 110mm (D)
- Weight: 1.2kg each
- With mounting brackets

C10189 $89.95

GREAT VALUE AT $69.95

MICRO SWITCH

NEW

- Single pole double throw
- Solder terminal • Standard size • Level action • Rated at 5A • 28 x 15mm

NOW $2.50 S13248 $2.95

MICRO SWITCH

NEW

- Single pole double throw • Solder terminal • Standard size • Rated at 5A • 28 x 15mm

NOW $2.50 S13250 $2.95

MICRO SWITCH

NEW

S13249 $6.95

- Single pole double throw
- Solder terminal • Minature size • Rated at 5A • 20 x 10mm

NOW $2.50

MICRO SWITCH

NEW

- Single pole double throw
- Solder terminal • Minature size • Rated at 5amp • 20 x 10mm

S13247 $2.50

GAS SOLDERING KIT

A multi-purpose unit that is available in this model as a gas soldering iron tool with solder tips. Can also be used as a: • Blow Torch • Hot Knife • Polyform Cutter or a Flat Flame depending on model purchased.

NEW

T12661 $24.95

MORE VALUE-FOR-MONEY PRODUCT!

SECURITY TORX DRIVER SET

Tool set with ratched handle and multiple bits. Supplied with security torx drivers and standard sized attachments. Total of 29 pcs.

T12177 $29.95

Contains 29 pieces & the handle to get torx bits

- Ratchet handle
- Bit holder
- Socket adaptor
- 8 star bits T8/T9/T10/T15/T20/T30/T40
- 4 slotted bits 4/5/6 & 7mm
- 2 hex bits H3/H4
- 7 hexagonal sockets 4/5/6/7/8/9 & 10mm

NEW

Illustration of bits is only indicative of comparative sizes and is not true to actual size.

SECURITY KIT

Protect your investments in computers and other office equipment with this kit. Easy to install and comes with a heavy duty lock with 2 sets of keys.

Contents:

- 7ft length coated steel cable • 3 permanent adhesive-backed mounting plates • 1 padlock and 3 sets of keys

BACK IN STOCK!

A15206 $19.95

IDEAL FOR HOME, OFFICE OR FACTORY SECURITY

MINATURE SWITCHES

SCMET/96-DEC/95S

S1 2001

Minature Rocker- on/off single pole single throw 250VAC- 10amp.

NEW

1-9 $1.95 10+ $1.50

S1 2002

Minature Rocker- on/off double pole single throw 250VAC- 10amp.

NEW

1-9 $2.95 10+ $1.95

S1 2007

Minature Rocker- with LED on/off single pole single throw 250VAC- 6 amp.

NEW WITH LED

1-9 $3.95 10+ $2.95

S1 2003

Minature Rocker- on/on single pole double throw 250VAC -10amp.

NEW

1-9 $2.95 10+ $1.95

S1 2005

Minature Rocker- on/off/on single pole double throw 250VAC 6amp.

NEW

1-9 $3.50 10+ $2.50

S1 3242

Minature Rocker- with neon light on/off double pole single throw 250VAC- 10 amp.

NEW

1-9 $3.45 10+ $2.95

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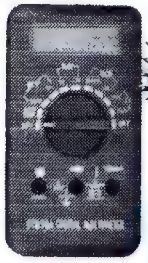
BACK TO SCHOOL ITEMS!! GREAT FOR EXPERIMENTATION & EDUCATION PURPOSES

BUDGET MULTIMETER



Q91566

EVERY HIGH SCHOOL STUDENT SHOULD HAVE ONE OF THISE

ONLY $24.95

Keep one handy in your car! You never know when you need to test equipment while on the road!

ROD IRVING ELECTRONICS No.1 FOR VALUE-FOR-MONEY PRODUCTS

Mid size digital mutlimeter with most standard ranges. Convenient for onsite jobs. 3.5 digital display. • 5 funcions • 9 measuring ranges • Supplied with leads and instruction manual. 1 x GP 1604 (9Volt) battery included.

SPECIFICATIONS:

DC Voltage:	0-20, 200
AC Voltage:	0-500
Resistance:	X2KΩ, X2000KΩ
DC amps:	200mA, 10A
Max Dc volts:	200V
Max AC volts:	500V
Battery tester:	1.5 and 9V

DIGITAL MULTIMETER Q13080

The ideal meter for technicians with a full 3½ digit LCD readout. Requires a 9V battery either alkaline or carbon. Expected life of carbon battery is 100 hours and 200 for the alkaline.

$59.95

SPECIFICATIONS

DC Voltage:	200mV-2-20-200-1000 volts
AC Voltage:	200-2-20-750 volts
DC Current:	200µA-2mA-20mA-200mA-2A-20A
AC Current:	200µA-2mA-20mA-200mA-2A-20A
Resistance:	200Ω-2kΩ-20kΩ-200kΩ-2MΩ-20MΩ
Diode Test:	Measures forward resistance in kΩ with a test current of 1.5mA max
Power:	Requires 1 x 9V battery

ANALOGUE MULTIMETER

Designed to measure AC and DC voltage, DC current, and resistance with accuracy and ease. can also be used as a battery tester. One AA cell (1.5V) provides power for ressitance measurement. 65cm insulated test leads with plugs included.

Q91562

$19.95

NOW $16.95

SPECIFICATIONS

DC Voltage:	0-2.5/10/50/250/500v
Impedance:	x10Ω, x1kΩ
AC Voltage:	10/50/250/500v
DC Current:	500µA-10mA-250mA
Resistance:	2k ohms, 200k ohms
Battery Test:	1.5V 9V
Sensitivity:	AC/DC voltage 2,000 ohms/volt
Power:	1 x 1.5v AA cell
Size:	10 x 6.4 x 3.5cm (HWD)

DIGITAL MULTIMETER

WITH CONTINUITY BUZZER & TEMPERATURE K TYPE PROBE.

Ideal for technicians with full 3½ digit LCD readout & continuity buzzer. 9V alkaline battery supplied. Expected life of battery is 200 hours.

Q13075 1-9 $29.95 10+ $24.95

SPECIFICATIONS:

DC Voltage:	200mV/2/20/200/1000V
Basic accuracy:	+/-0.5%
Input Impedance:	1M
Maximum output:	1000V DC
AC Voltage:	200/750V
DC current:	200A/2000A/20mA/200mA/10A
Resistance:	200Ω/2000Ω/20kΩ/200kΩ/2M
LCD Display:	15 x 46mm
Outer case size:	125 x 77 x 28mm

Temperature measuring features:

Range:	-20° to 1370° C
Resolution:	1° C
Accuracy:	±3° ±2D (up to 150° C) ±3% of rdg (over 150° C)

DIGITAL MULTIMETER

The ideal meter for technicians with a full 3½ digit LCD readout. Requires a 9V battery either alkaline or carbon. Expected life of carbon battery is 100 hours and 200 for the alkaline.

Q13070

$34.95

SPECIFICATIONS

DC Voltage:	200mV-2-20-200-1000 volts
AC Voltage:	200-750 volts
DC Current:	200µA-2000µA-20mA-200m A-10A
Resistance:	200Ω-2000Ω-20kΩ-200kΩ 2000kΩ
Diode Test:	Measures forward resistance in kΩ with a test current of 1.5mA max
Power:	Requires 1x 9V battery

ANALOGUE MULTIMETER

A pocket sized multimeter that includes 5 functions and 16 measuring ranges. Single knob function control makes it very simple to use. Comes complete with test leads and instructions and is ideal for the handyman - can be kept in the glove box of the car.

Q13060

$17.95

SPECIFICATIONS

DC Voltage:	0-2.5-10-50-250-500 volts
AC Voltage:	0-10-50-250-500 volts
DC Current:	0-500µA-10mA-250mA
Resistance:	Rx10, Rxl k (centre 3.6)
Battery Test:	1.5V 9V
Sensitivity:	2k ohms/volt DC/AC
Power:	Requires 1 x AA battery

JACOB'S LADDER DISPLAY

Ever since scientific showmen like Tesla and Edison were able to generate really high voltages, the Jacob's Ladder display has been creating awe amongst laymen.

SC SEPT'95

Without COIL K10695 **$29.95**

With COIL K10696 **$59.95**

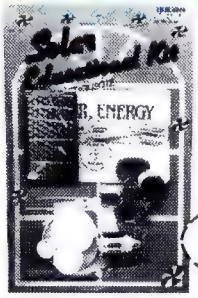
18 WATT SOLAR PANEL

12V VAC 16V (max) 18V Isc 800mA (max) 1000mA

Z19036

$199.00

SOLAR EDUCATIONAL KIT



Now you can experiment with solar energy....the energy source of the future. Our solar educational kit is designed to let you build your own solar models.

Z19041

$12.95

This kit comes complete with:
• Solar cell module • Solar energy booklet explaining the whys and hows of solar energy • Small DC Motor • Screws and nuts • Wire with motor clips • Coloured spinner discs • Paper aeroplane and bird models • Plastic turnables with 4 sizes, 5/8", 1", 1½", and 2" • Plastic fan-spinner

The solar cell modules, when placed in direct sunlight or close to incandescent light bulbs, generate power similar to batteries. Discover for yourself how to harness the energy of flight and employ it in countless practical applications. Solar energy uses are limited only by your imagination.

SOLAR MOTOR KIT

This is a great starter kit consisting of a 0.9V 400mA solar cell and a small motor with a 48" wire. Great for beginner or just the curious!

Z19040

$9.95

PC- DRIVEN ELECTROCARDIOGRAM

This simple project will let you take your own electrocardiograph, and display it on a PC. With the software supplied, you can read, display, save to disk and print the electrical waveform generated by your own heart (or anyone else's). Powered by a 9V battery and electrically isolated from the computer, the PC-ECG is a safe, low cost way to monitor the electrical activity of the heart. ***EA JULY '95***

A BUDGET PRICED "SHOESTRING" STEREO AMP

Power rating of around 15 watts per channel and impressive noise and distortion performance, this low-cost amplifier is ideal for smal Hi Fi systems, "home theatre" installations, and a host of other applications. Uses readily available parts, offers a basic range of features and is easy to put together. Ideal for schools, college or University project or built to work as a multimedia amplifier. ***EA JULY '95***

K10650 **$99.95**

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MULTIMET3-NOV95S

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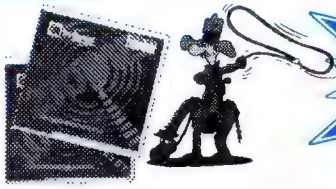
SYQUEST PRODUCT RANGE ROUND-UP -

FOR EVEN MORE AFFORDABLE BACKUP AND FILES EXCHANGE BETWEEN COMPUTERS



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HERE'S A VERY ECONOMICAL WAY TO BACKUP FILES AND TRANSFER INFORMATION...

INDUSTRY STANDARD 3.5" HIGH PERFORMANCE REMOVABLE CARTRIDGE HARD DISK DRIVE.

FEATURES INCLUDE:

- ANSI ATA interface (IDE SCSI available as option) provides 14.5msec access time
- Offers primary and secondary storage in one drive.
- 64K intelligent read "Look Ahead" caching buffer.
- Data transfer rate at the host interface up to 4.0MB per second
- Data transfer rate from the head / media interface is up to 2.3 MB per second.
- Programmable power modes - sleep, stand-by idle and active
- 20,000 cartridge insertion cycles
- 100,000 start/stop cycles
- Ergonomic engineering for reliable and easy cartridge loading and unloading
- 100,000 hours MTBE with 100% duty cycle
- On-the Fly error correction
- 1-7 RLL modulation recording for maximum read window margins.
- Removable storage advantages - including unlimited capacity and off-line storage, data transportability, system sharing, data security and fast backup.

The 3.5" SQ3105 drive is designed for all laptop/ desktop computers.

Our 3.5" drives provide universal interchangeability through the use of an embedded servo system and adaptive read channel, while including comprehensive self-diagnostic capabilities and programmable power-saving modes.

AS USED BY

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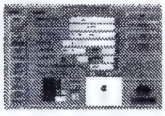

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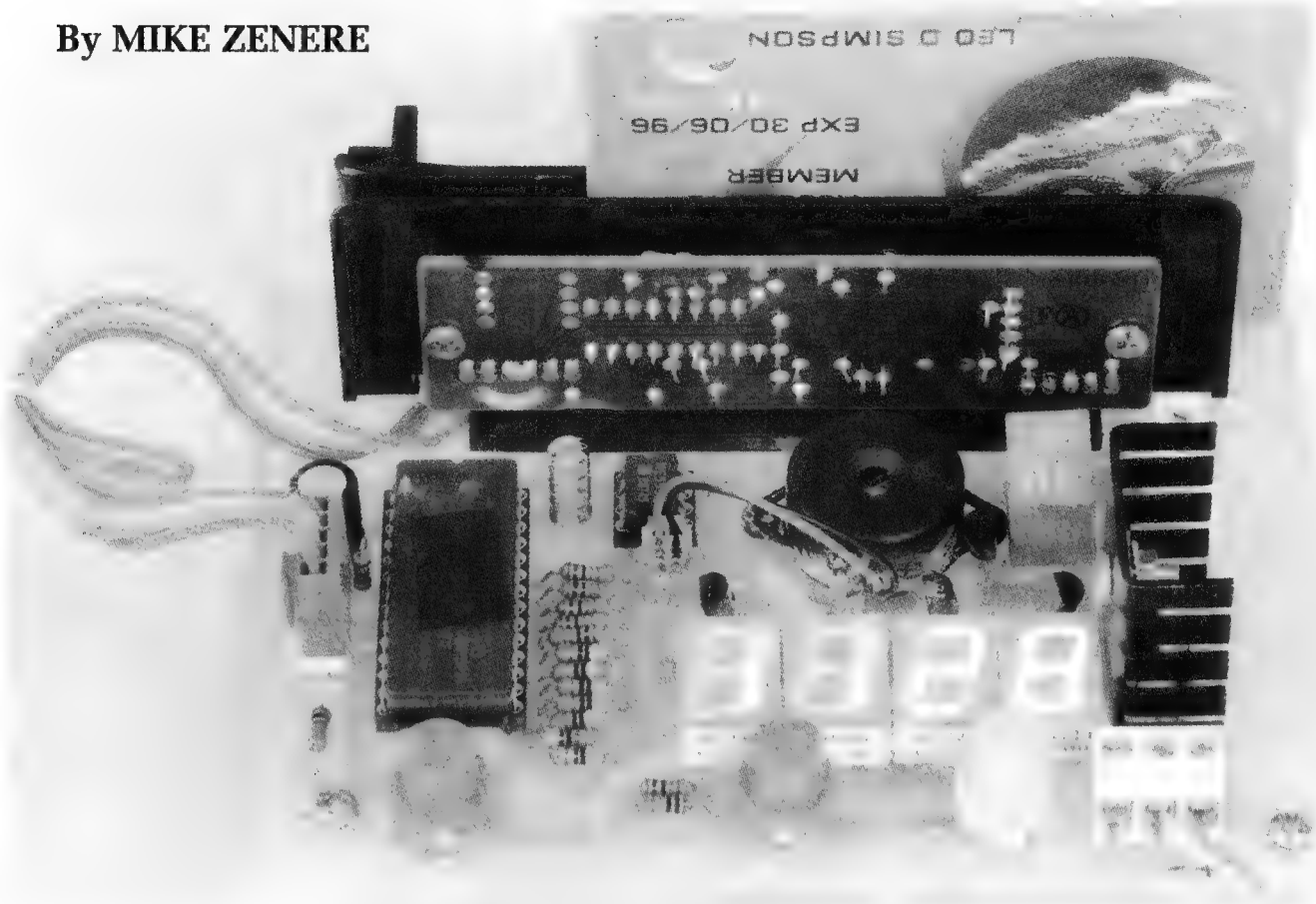

Build a magnetic card reader & display

Have you ever wanted to find out what's written on your credit card or other magnetic stripe cards? Now you can do it. This unit will enable you to read and display the contents of track two on any magnetic card and could be used as the basis for an electronic door lock.

Magnetic cards have been around for many years and have found their way into many fields such as banking, security and vending machines. Most cards follow defined guidelines as to their construction and layout and are therefore very flexible to the designer. Each card has three tracks but the most commonly used is track two.

Recalling data from the card has become relatively simple in the last few years with modern card readers. These generally have a single on-board chip to decipher the raw data from the read head. This looks much like the record/play head in a cassette deck.

The on-board chip generally contains conditioning circuitry to pick up the signal, reject noise and provide a digital output. Most card readers interface via three wires which are Clock, Data and Card Valid.

Assuming that a microprocessor is hooked up to the card reader, a typical card read takes place as follows. When a card is swiped through the card reader, the Card Valid line goes low after eight or nine flux reversals, indicating that a valid card is present.

The microprocessor monitors the clock line and waits until the Clock

Magnetic Card Standards

Most magnetic cards adhere to defined standards that describe the physical as well as electrical layout. The standards outline card size, magnetic stripe and track positioning, and format information.

The information is recorded onto the card using a technique known as Two Frequency Coherent Phase Recording or F/2F. This allows for serial recording of self-clocking data on each track. The data consists of data and clocking bits together. When a flux transition occurs between clock cycles, a "one" is obtained and when there is an absence of flux between cycles a "zero" is obtained.

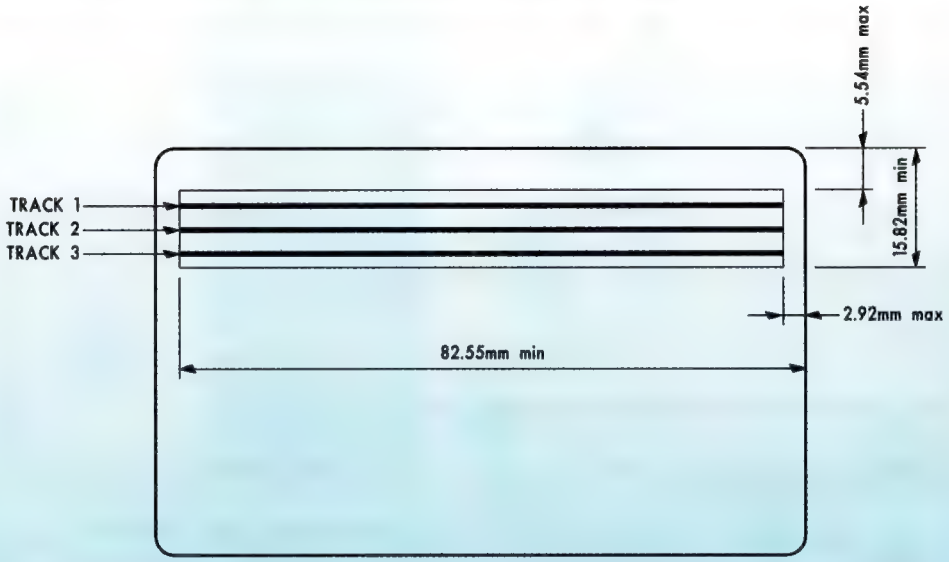

Fig.1: the track layout on a magnetic card. Track 1 can record alphanumeric data, while tracks 2 and 3 provide only numeric data.

Standard magnetic cards have three data tracks and each has its own subtle differences. Track 1 has a bit density of 210 bits per inch, giving it the ability to hold a total of 79 characters over the entire length of the card. Each character on this track is made up of six data bits and one parity bit, providing 64 different alphanumeric combinations to choose from. The card and track layout is shown in Fig.1.

The remaining tracks, two and three, provide only numeric data and have a bit recording density of 75 bpi and 210 bpi respectively. The character set for these two tracks is encoded using 4-bit BCD with odd parity.

All tracks are recorded with the least significant bit first and the parity bit last. The higher density track three holds up to 107 numerics while track two holds only 40. The necessity for start and end sentinels and other separating characters reduces the above storage capabilities to a certain extent.

Reading or writing of data to the card generally follows the same path for all three tracks. First, leading zeros are encoded to indicate the presence of data and to provide synchronisation. Next, the start sentinel is encoded to indicate the start of the actual data to be read, followed by the data, the end sentinel, LRC and finally, trailing zeros to the end of the card. The term LRC stands for "longitudinal redundancy check" and is used for horizontal error detection.

By far the most commonly used track is track two. Although holding less information than the others, this track has all the data required to do a banking transaction. If there is a need for the customer's name to be present, then track one is used as it is the only one that holds alphabetical characters. The third track is special in that data may be written or read during a transaction.

line goes low, indicating that data is present on the data line. The data bit is collected and temporarily stored until a succession of bits is gathered to make a 5-bit word, with four data bits and one parity bit. When the 5-bit word is obtained and stored, the cycle repeats itself until all the 5-bit characters have been read into memory. The processor can now go back over the data and analyse it for parity.

Date rate & swipe direction

The data rate even for the high density tracks is quite low, allowing almost any microprocessor to sample and collect the data. Let's assume that the card is passed through the reader at around one metre per second.

This translates to around 9983 bps or 1426 7-bit characters per second, meaning that a new data bit is presented about every 100µs. Most card readers are capable of reading two of the three tracks in one swipe. Even allowing for this extra load, most microprocessors running at 1MHz or more will handle this with ease.

Although data is written onto the card in a particular format, there being a start and end sentinel, this does not limit the programmer to write software to read a card when swiped forwards or backwards. In a "backward read", the card data is simply read as usual and stored in memory but this time the last character is first and the first character is last. The program simply detects this by looking for the start and end sentinels and then corrects itself.

Card reader

The card reader and display unit to be presented here is self-contained on

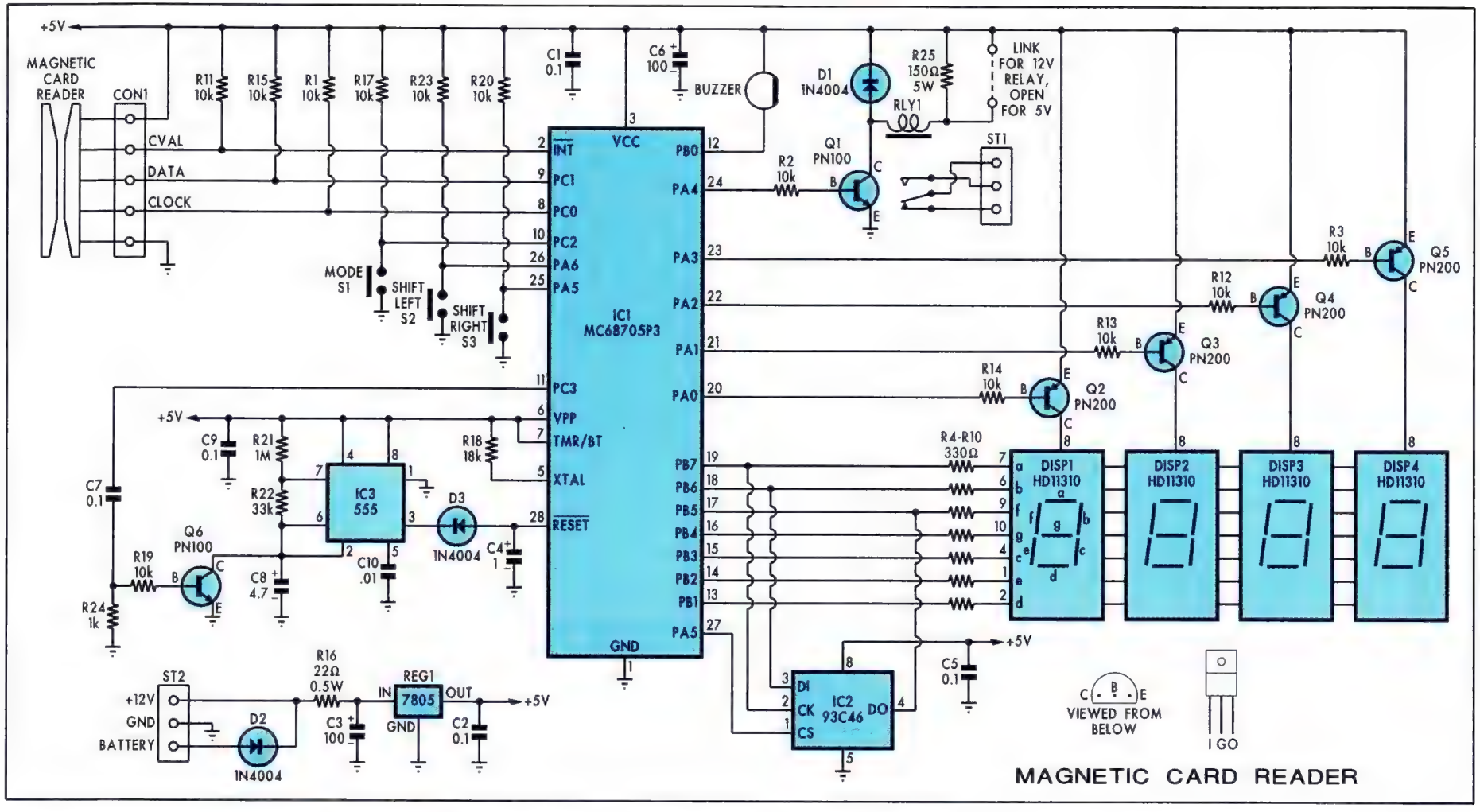

Fig.2: the circuit is based on a magnetic card reader module with its own on-board decoding. The data from this module is fed via three lines to the microprocessor (IC1) and this in turn drives a multiplexed 4-digit display. The track 2 contents of four cards can be stored in the EEPROM (IC2) and this data can be used as the basis of an electronic door lock. IC3 and its associated parts form a watchdog timer circuit and this automatically resets the microprocessor if signal activity from pin 11 ceases, indicating that the processor has "crashed".

a PC board measuring 128 x 101mm. As well as the card reader module with its integral PC board, there is a 4-digit display, a 28-pin 68705P3 microprocessor (IC1), a piezo buzzer and three pushbuttons. The circuit is shown in Fig.2.

The card reader and its integral PC board has all the circuitry necessary to decode and convert the raw data coming from the card being read. The data is transformed into logic levels and is then sent out via three serial lines to the processor. The card reader is connected to the logic board via a 5-way cable, with three of the lines for data and the other two for power.

The recording function of the circuit is performed by a small serial EEPROM, IC2. Once the unit is placed in the record mode and a card is swiped through, the data will be saved in the EEPROM.

Because timing is not critical in this project, a crystal for the microprocessor is not necessary. Instead, by placing an 18kΩ resistor from pin 5 to the +5V rail, an inbuilt oscillator is enabled, causing the processor to run at near full speed.

Beeper & relay driver

A DC self-oscillating beeper is connected to port B, pin 12, on the processor. Port B can sink up to 10mA which is sufficient for this application and is pulled low to turn on the beeper.

The relay is driven by transistor Q1 which is controlled by the line from pin 24. This line is normally low and the relay is off. When a valid card is swiped through the reader, the processor port pin 24 goes high for a period of time and turns on Q1 which operates the relay.

The display consists of four 7-segment common anode displays multiplexed together. The cathodes are driven directly by port lines from the processor, while each display anode is driven by its respective PNP driver transistor (Q2-Q5).

The processor receives an interrupt every 5ms from an internal timer. Each time an interrupt is received, the processor switches off the current display digit that it is driving and turns on the next. In this manner, each digit is only on for 5ms before the next digit is updated. This gives each digit a total on-time of around 250ms per second; ie, a duty cycle of 25%.

The SHIFT LEFT and SHIFT RIGHT buttons are used to move the display laterally to enable the user to view the entire number.

Construction

Begin assembly of the PC board by mounting the four standoffs, one at each corner. This done, install the diodes, resistors, links and capacitors. Note the polarity of the electrolytic capacitors and the diodes. Install the 7805 regulator and fit it with a small heatsink.

Next, install the transistors, the two small ICs and the socket for IC1 but do not install the processor until after the unit has been powered up and a voltage check performed. When installing the four 7-segment displays, their decimal points should be close to the edge of the PC board.

The remainder of the components can now be mounted, noting the orientation of the pushbutton switches. The card reader module is attached to the PC board with screws fitted from the underside. The back of the read head should face the outside edge of the board.

When all the assembly work is complete, apply 12V DC to the board and check that +5V is present at pins 3 & 6 of the socket for IC1, at pin 8 of IC2, pins 4 & 8 of IC3 and at the emitters of Q2-Q5.

If this checks out, remove the power, plug in the processor and connect the card reader module. Reapply power – the buzzer should beep four times and the display should read "OPEr". The unit is now ready for a test drive.

Before you start, here are a few tips. The mode button is used to cycle through the various available modes. Each time you press this button, the next option appears on the display. The modes are OPEr (operate), rEC (record), dEL (delete), pLAY and rEAd. When in the operate mode, the display blanks out after about 30 seconds to conserve power. If any button is pressed after this time the display will light and programming may continue.

Initial set up

If this is the first power-up you will need to reset the memory of the EEPROM and this is done by holding down SHIFT LEFT and SHIFT RIGHT and applying power. The EEPROM will be cleared and the relay on-time will be set to three seconds.

PARTS LIST

1 PC board, 128 x 101mm
1 magnetic card reader module
1 piezo buzzer
1 12V miniature SPDT relay
3 momentary contact pushbutton switches
1 5-way connector
1 2-way connector
2 3-way PC-mount insulated terminal blocks
4 PC standoffs

Semiconductors
1 MC68705P3 programmed microprocessor (IC1)
1 93C46 EEPROM (IC2)
1 555 timer (IC3)
1 7805 5V 3-terminal regulator (REG1)
4 HD11310 7-segment red LED displays (DISP1-4)
3 1N4004 silicon diodes (D1-D3)
2 PN100 NPN transistors (Q1,Q6)
4 PN200 PNP transistors (Q2-Q5)

Capacitors
2 100µF 16VW electrolytic
1 1µF 16VW electrolytic
4 0.1µF monolithic

Resistors (0.25W, 5%)
1 1MΩ
1 33kΩ
1 18kΩ
11 10kΩ
1 1kΩ
7 330Ω
1 22Ω 0.5W

Miscellaneous
Screws, nuts, shakeproof washers, solder.

Where to buy the parts

A complete kit of parts for the magnetic card reader is available from the author. This includes all electronic components except for the 12VDC power supply and a case. The price is $75.00 plus $7.50 for postage and packing.

Completely assembled and tested units are also available at an extra cost of $20.00. The documented source code is a further $8.00 for the print out.

Please make postal money orders payable to Mike Zenere, 83 Headingley Road, Mt. Waverley, Vic 3149. Phone (03) 9803 3535.

Note: copyright© of the PC board is retained by the author.

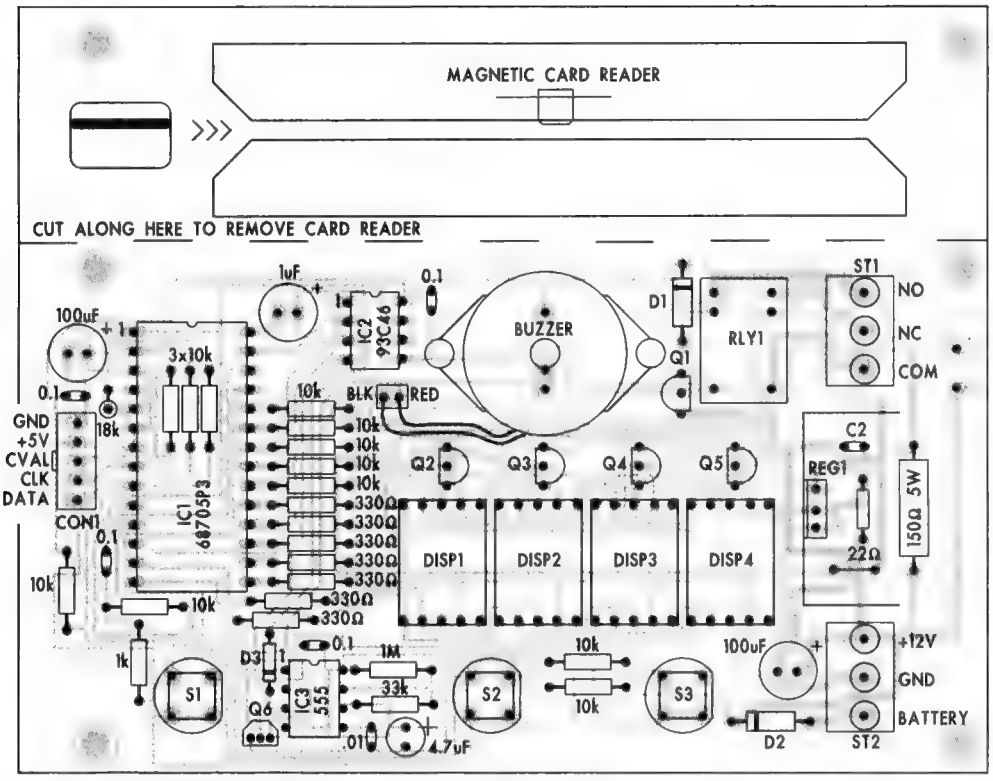

Fig.3: install the parts on the PC board as shown here, taking care to ensure that the displays, switches and other polarised parts are correctly oriented. The card reader module is connected to the main PC board via a 5-way cable.

The unit can be used in two modes which enable the user to: (1) read and display cards; and (2) operate the relay. Let's initially talk about the first option. After power-up, the unit should be showing "OPEr" indicating that it is in the door access mode. To change this, push the mode button until the display shows "rEAd", indicating that if a card is swiped, its track 2 contents will be displayed.

Swipe any card through and you should see some digits or letters on the display. These will correspond to the digits stored on the magnetic card with the start sentinel (b) being the first character. The display can only show four numerics at a time so to view the rest, push the SHIFT LEFT button once to view the next character to the right.

Keep doing this until the display shows the end sentinel (F) or until the display shifts no further. While doing this, look at the front of the card and its embossed number. You should see this number appear in the display as you move along. If you wish, you can move the display to the right by pushing the SHIFT RIGHT button.

To view another card, simply swipe it through the slot.

Door lock applications

The following functions relate to the operate mode which is when the unit is used as a door lock. After going through the functions listed below, place the unit in the operate mode by hitting the mode button until "OPEr" is displayed. After a short time, the display will blank out and the unit will now be ready to compare swiped cards with its memory contents. If a match is found, the door release relay will operate for a set time and a single beep will be heard. If no match is found, two beeps will be heard.

Recording a card

The unit can store up to four cards in the serially fed EEPROM. The MODE button is hit until the "rEC" message is displayed. If the memory is full, there being four cards stored already, the display will alternate between "FULL" and "rEC" and you will not be able to store any more cards until you have used the delete function. Each time a card is entered, the unit jumps back to the operate mode until the function key is once again hit.

Deleting a card

You can delete a previously entered card by first hitting the mode button until "dEL" is displayed. Swipe the card to be deleted through the slot and if the card is found and deleted from memory, a single beep is heard. If the card is not found the unit will beep twice.

Relay operation

When a card has been successfully recognised by the unit, it will operate the relay for a set time which will be between one and nine seconds. To set this time, hit the MODE button until the "rLAY" message is shown. Hit either of the SHIFT buttons to display the current setting.

Using the SHIFT LEFT and SHIFT RIGHT buttons, set the relay on-time in the display to the desired number; eg, the display may show something like 0002, indicating that the relay will operate for about two seconds.

Hit the mode button again to save the new number in memory.

If using the unit as a door lock, you can remove the magnetic card reader module from the PC board and extend its connecting cables to enable the two sections to be housed separately. The two separated units can then be mounted on either side of the wall to provide greater security.

Battery back-up

Provision has been made for battery back-up in case of a power failure. The battery GND is commoned to the power supply ground and the battery +12V is connected via D2. **SC**

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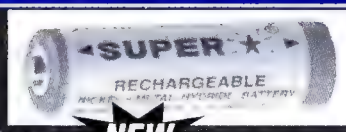

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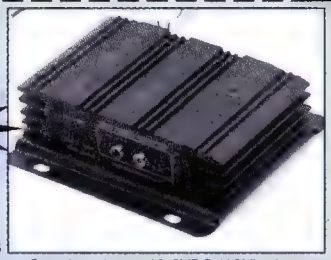

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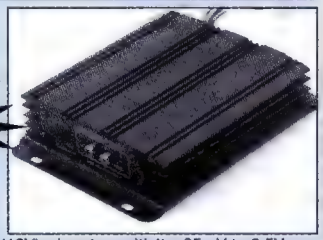
Cat. AA-0415 **$45.00**

CAR AMPLIFIER 30WRMS X 2

OUTPUT POWER 30WRMS / CHANNEL

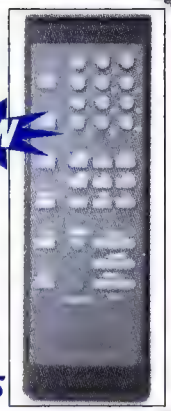


NEW

If 18W RMS/channel is not enough, then look at this unit. Features include high input gold RCA sockets, as well as low inputs, an input gain control and power LED indicator. Outputs to speakers are by push terminals. Output power is a genuine 30 watts RMS per channel into 4 ohms. Specifications: •Supply voltage: 13.8VDC (12V) •Input sensitivity: 65mV to 2.5V adjustable •Output power: 30WRMS / channel 4 ohm •Distortion: 10% max volume •Frequency response: 25Hz to 20kHz •Channel separation: 50dB •Signal to noise ratio: 60dB •Idle current: 13mA •Max Current draw: 13A •Weight: 1kg •Dimensions: 150 x 103 x 41mm

Cat. AA-0420 **$75.00**

PROGRAMMABLE REMOTE CONTROL



NEW

This remote control will "learn" the functions of other remotes. If your TV / stereo coffee table has a row of remotes, you can actually retire them all and just use this one. Also ideal if one of your remotes is "on the way out". Before it dies, buy one of these and it will learn the functions. Brand name replacement remote controls cost a fortune.

Specs: •Memory capacity: 150 commands •Memory hold without batteries: About 8 minutes •Suitable equipment: Most brands of infra red remote controllers for audio/video devices •Effective range: 8 metres •Power source: 4 x AAA batteries (not supplied) •187(L) x 64(W) x 15(D)mm

Cat. AR-1710 ***$43.95***

LASER POINTER

NEW

If you need to point out objects or details that are out of reach, then you need a laser pointer. Up until now you have had to pay around $140, but not at Jaycar. Laser Pointer is small and easy to hold, and has a push on switch for operation. Requires 2 x AAA batteries. Supplied in a plastic case for storage. Specifications: •wavelength - 670nM at 50 metres, 650nM at 150 metres, 630nM at 300 metres •size - 140 x 18 x 15mm. Class 2 laser product. Do not store into beam.

Cat. ST-3100 **$89.50**

Jaycar 2.8 Amp 24 to 12 Volt Reducer

NEW

New smaller model for 1996. Ideal for cellular phones. This reducer will drop 24 volts to 12 volts with continuous loads of 2.8 amps. It is fully protected (see specs) and is ideal for truckies running a 12 volt cellular phone on the 24 volt truck power. And the price is lower than last year.

Cat. MP-3058 ***was $49.95*** ***NOW $39.95***

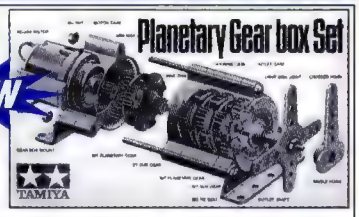
Jaycar 7.5 Amp 24 to 12 Volt Reducer

NEW

New model for 1996. This Switch Mode reducer will drop 24 volts to12 volts with continuous loads of 7.5 amps. This unit offers very high efficiency - up to 90%, its much smaller physically than the one it replaces, and it has internal current limiting.

Cat. MP-3060 ***was $92.50*** ***NOW $69.95***

Planetary Gear Box Set



NEW

Automatic transmissions in cars use planetary gear clusters. They are simple, compact and strong. This gear set made in Japan by TAMIYA is sensational. Why? Firstly you can configure the gearbox to 8 different reduction rates 4:1, 5:1, 16:1, 20:1, 25:1, 80:1, 100:1 and 400:1. A genuine MABUCHI RC-260 3VDC motor is included! (at 400:1 the gearbox gives a massive 15kg/cm of torque)! Typically Japanese, it is thorough. Absolutely everything is supplied including tubes of lubricating grease, mounting feet, two drive attachment cranks and a beaut brass double female coupling to connect to other (drive) shafts. You will love this product! •Measures 100mm long x 28mm(dia of body), height including mounting feet 38mm. Steel output shaft 4mm dia •Can be ganged for up to (max) 160,000:1 •Moulded out of sturdy ABS plastic

Cat. YG-2720 ***$39.95***

JAYCAR NOW OPEN IN PERTH

4.5 DIGIT DMM SELLOUT

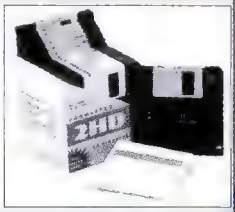
FEATURES: •Frequency Counter •Transistor Test •Capacitance •Data Hold •Auto Power Off •Large Display •Overload Protection •Diode Test •20A •19999 Count. See cat p 27 for details. Cat. QM-1330

1994 Price $129.50

1995 Price $99.95

NOW ONLY $79.95

CHEAP DISKS!!!



NEW

Save even more on 3.5" HD IBM formatted disks. 100% error free and includes user labels. CAT XC-4740

Don't pay $19.95

Pkt 25 Only $13.95

JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS
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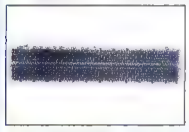
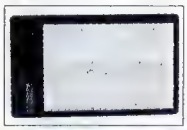
Save on Breadboard for January

See catalogue page 130 for full details.

Cat	Description	Normally	Jan	Save
PB-8810	Distribution strip 100 hole	$4.25	$2.95	$1.30
PB-8812	Terminal strip 630 hole	$13.50	$9.95	$3.55
PB-8814	830 tie points	$18.95	$13.95	$5.00
PB-8816	1660 tie points on plate	$44.95	$34.95	$10.00
PB-8818	2420 tie points on plate	$56.95	$46.95	$10.00
PB-8820	3220 tie points on plate	$75.00	$62.00	$13.00

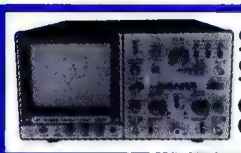



SAVE ON CROS

25MHZ CRO $749
2 PROBES $79
$828
Jan Pay $699

QC-1900

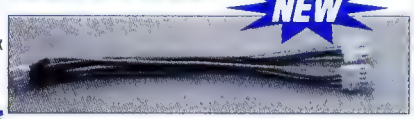
50MHZ CRO $1195
2 PROBES $79
$1274
Jan Pay $1095


QC-1910

Cable For 2 Disk Drives

NEW

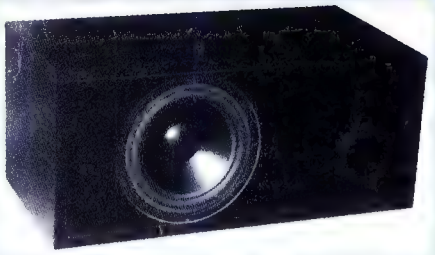
This lead has one 3.55" floppy disk drive plug to 2 x 3.5" drive power sockets.
Cat. PL-0753



$5.95

SAVE ON VIFA JV80 - SUBWOOFER

QUOTE FROM ROB EVANS IN ELECTRONICS AUSTRALIA MAGAZINE.
"The JV80 performed extremely well in both our subjective and objective tests, and really did demon-strate how a refined driver such as the Vifa M22WR can deliver the goods in a correctly tuned enclosure".



AS REVIEWED IN ELECTRONICS AUST. JUNE 95
The driver has an impedance of 6 ohms, so could also be used in a car situation. The power handling is very large, for such a small driver being 150 watts nominal (RMS) a long term max rating of 300 watts (on for one minute, pause for two minutes) and a short term max power of 500 watts (on for one second, pause for one minute). We also recommend you use a polyswitch RXE300 Cat RN3472 $10.95. To simplify, any amplifier between 30 and 200 watts can be used. Look at our new Subwoofer Amplifier Kit.
The enclosure is very small with a volume of 35 litres and only 600 x 270 x 300(D)mm. The cabinet is supplied prebuilt and is made from MDF in blackwood veneer. Grill is supplied with speaker cloth mounted.

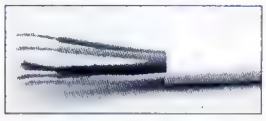
SPEAKER ONLY
VIFA M22WR 8" **Cat. CW-2115**
Normally $199.50
Jan Price $179.50 ea
SAVE $20

SUBWOOFER KIT
INCLUDES: •VIFA M22WR DRIVER • PREBUILT CABINET •POLYSWITCH
Catalogue Price $349.45
Jan Price $299
SAVE ALMOST $50

ROAD FREIGHT ANYWHERE IN AUSTRALIA $14. INSURANCE $3

6 Core Phone Cable Sellout

SAVE A FORTUNE! Our new cable is Austel approved. This stuff isn't. Limited quantity only.Austel approved cable is 0.75¢ metre or $48 roll



This cable is **0.40¢** metre or **$28** roll
Cat. WB-1603

MAJIC EAR

Majic Ear is an amazing aid to hearing that sits comfortably behind your ear and magnifies sound with superb clarity. If you have trouble hearing the TV, listening to the radio etc than Majic Ear will help. There is also 3 different earpieces so you can be assured of a perfect fit. There is an adjustable volume control and an on/off switch. Complete with battery and a spare. Don't put up with trouble hearing!!! Cat. QM-7230

Cat Price $29.50 ***NOW $19.50***

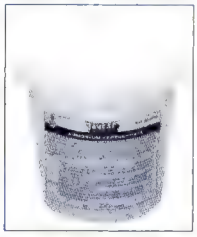
UNIDEN Cordless Phone Sellout!!!

We have a very small quantity of these phones left. See catalogue page 106 for full details.

CAT PRICE $229
Sellout Price $189
SAVE $40 Cat. YT-7040

Ammonium Persulphate Bucket

Save a fortune. 2.5kg bucket.
CAT PRICE $29.95
Now $22.95
SAVE $7
Cat. NC-4256



DOLBY PRO LOGIC CENTRE SPEAKER KIT BARGAIN

Kit includes:

•2 x 5" shielded woofers Cat CW-2102	Value $79.90
•1 x 1" shielded dome tweeter Cat CW-2006	$16.95
•1 x crossover network Cat CX-2613	$8.50
•1 x set box plans / wiring details	$105.35

Only $89 **SAVE OVER $16** **Cat. CS-2500**

LED Display Bargain

LTS313AR /LT303 common cathode 0.3". Peak wavelength 700, IFMA10 .1V(VDC)650
Cat. ZD-1803

CAT PRICE $2 EACH
Jan 10 for $10

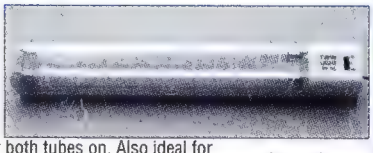
TELEPHONE EXTENSION LEAD

This lead has a 15 metre length of telephone cable with a U.S. 4 pin plug on each end. Also supplied are two adaptors. One accepts the U.S. plug and converts it to an Australian plug. The other adaptor is from the U.S. plug to and Australian socket. So you can have any combination of U.S. plug to Aust plug, U.S. plug to U.S. plug or U.S. plug to Aust socket all 15 metres long. Adaptors cost $6.50 each and the lead is $12.95. That's over $25 value. Austel approved.

Cat: YT-6050 **Cat Price $13.95** **JAN $9.95**

12V 16W TWIN TUBE FLURO LIGHT

This fluro light runs off your 12V car power and plugs into the cigarette lighter. It has a magnetic base, so its easily attached to a van, and you can have one or both tubes on. Also ideal for lighting sheds, or houses without 240 volts.



Cat. ST-3025 **only $24.95** NEW

GIFT VOUCHERS AVAILABLE

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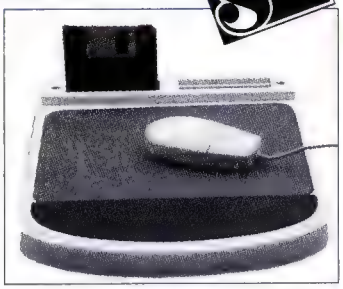
Mouse Station

SAVE



Mouse station is ergonomically designed to rest your wrist and reduce the risk of Carpal Tunnel syndrome. As well as the padded wrist support, it includes a mouse pad and a slide out drawer at the rear. The drawer will hold 10 x 3.5" floppy disks plus pens etc. Total size 350(D) x258(W)mm.

Mouse and disk not supplied.

Cat. XM-5098 **Catalog Price $19.95**

FOR JANUARY $13.95 Save $6

AMAZING VALUE DMM'S FROM JAYCAR

BRILLIANT RANGE OF MULTIMETERS ALL OFFER UNBELEIVABLE VALUE FOR MONEY

For full specs and the features associated with each model see our 1995 catalogue.

Low Cost
- 3.5 Digit 12.5mm High Display LCD
- Transistor Test
- Diode Test
- 10 Amp Current

QM-1500 $29.95

Pocket
- 3.5 Digit
- Wrap around leads
- Small size
- One hand operation
- Continuity • Diode

QM-1520 $34.95

30 Range
- Large Display
- Transistor Test
- 20 Amp
- Diode Test

QM-1300 $49.95

Temperature
- Frequency Transistor
- Diode, Continuity
- Capacitance
- Auto Power Off
- Large Display • 20A

QM-1320 $69.95

Auto Range
- 3.5 Digit
- 1999 Count
- Data Hold
- Bargraph
- Holster
- Diode • 10 Amp

QM-1530 $89.95

COMPUTER OPERATOR FOOT REST

SAVE

This foot rest is designed for computer operators, and is suitable for anyone who sits at a desk.

The footpad measures 420(W) x 280(H)mm, and is ribbed.

The angle of the pad is easily adjustable (by your feet). Its simple to assemble and is grey in colour.

Cat. XC-5160 **Catalogue Price $22.95**

NOW ONLY $12.95 Save $10

AMAZING LIGHT GLOBE STROBE

Thats right! A powerful high energy strobe light that will fit a standard 240V bayonet type light globe socket!! There are many uses for such a product. On the factory floor you can replace red warning lights with much more visible flashing ones. Replace some of the globes in your outdoor festoon party lights with dramatic effects. Ideal use in discos and advertising signs etc. Features: •xenon flash tube with all electronics in base •flashes approx 120 times / minute •visible for miles •only draws 1 watt average at 240V •easy installation - needs a bayonet type light socket •3 colours avail.

NEW

Cat YS3020 Clear / YS3022 Red / YS3024 - Blue

Only $19.95 ea or 10 up (mixed) $17.95 ea

BULK USERS CONTACT OUR WHOLESALE DEPT FOR SPECIAL PRICES

Desktop Copyholder

SAVE

Tilting bail, adjustable document clip and sliding rule.. Colour is black.

Cat. XC-5152

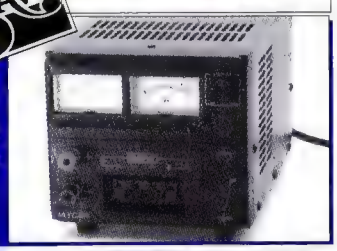
Cat Price $14.95

JAN $9.95

Save $5.00

Save $50 On 0-15 VDC 25Amp Adjustable Regulated Laboratory Power Supply

SAVE



NORMALLY $349.50

SAVE $50 Cat. MP-3088

JAN ONLY $299.50

CAR ALARM SENSATION

Amazing scoop purchase from Importers Distress allows you to save a fortune.

Road Alert RA-52 is a remote control car alarm, the siren (110dB) sounds inside the car - making it too unbearable for the theif to stay there. The RA-52 is a versatile portable alarm that can be armed / disarmed manually, or by the infrared remote control supplied. It will operate from a rechargable 9v battery, or direct from the cars power, hard wire connected or through the cigarette lighter socket. All leads supplied.

This is a unique car alarm, that works extremely well, and is an ideal investement to help "Keep Your Car". Cat. LA-8950

SAVE

Retail Price was $179

Distress Purchase Price $79.50 JAN ONLY $49.50

SAVE

Transistor 2SC2545 Giveaway

2SC2545 is a NPN ultra low noise device.

•Case is TO-92 •Diss @ 25°C is 400mW

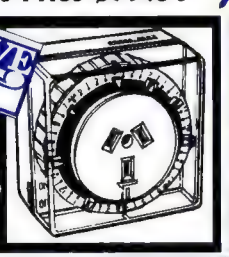
•Vcb is 60V •IC is 100mA.

Cat. ZT-2400 **Cat Price $2.95**

Now 10 for $2

24 Hour Arlec Timer

SAVE



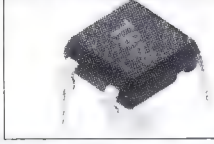
Ideal for pumps, lights, heaters etc etc etc.

Cat. XW-0400 **was $27.95**

Now $19.95

BUY 10 LESS 10%

4 DIL Bridge Rectifier



A small bridge that fits into an IC socket. No is 1B4B42. Rated at 1A 100V.

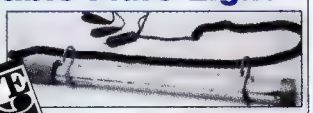
Cat. ZR-1308 **$1.20**

Save $3 On 12V 13W Portable Fluro Light

Supplied with hangup clips. Power lead with alligator clips and lighter plug. **NORMALLY $19.95**

JAN $16.95 SAVE $3

Cat. ST-3020



SAVE

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STEREO INFRARED CORDLESS HEADPHONES

NEW

These are very similar to the mono ones shown above, but transmit in stereo. Use on your Hi Fi or stereo TV etc. To use, plug the transmitter into the headphones or output socket (lead supplied). Transmitter sits on top of your TV or stereo. Headphones have a separate volume control on each and require 2 x AAA batteries. Operating distance is up to 7 metres. Unit requires 12VDC mains adaptor. Use an existing one or purchase our cat MP-3006 $15.50.

Cat. AA-2004 **$79.95**

14,400 BPS DATA/FAX MODEM Internet Software Included!!!

NEW

AUSTEL APPROVED

SPIRIT SWIFT

This is a fully featured modem on a circuit card ready to plug straight into the motherboard of your PC. Why clutter your workspace when your modem can be inside your PC!!!

The Swift will send and recieve faxes at the new V.17 standard of 14,400BPS as well as falling back to the slower speed of 9,600 BPS. This is a very clever modem which loses nothing to black box units.

SPIRIT SWIFT INCLUDES: •Spirit Swift fax modem •Winfax lite, DOSfax lite and Comit lite for DOS and Windows •2 metre phone cord •User manual •OzEmail internet software

SPECIFICATIONS: •ITU-T V.32bis, V.32, V.22bis, V.22 and Bell 212A compliant •14,400/12,000/9,600/7,200/4,800/2,400/1,200/300bps •ITU-T Group III, Class 2 send and receive fax at up to 14,400bps •HARDWARE ITU-T V.42bis and MNP 5 data compression •HARDWARE ITU-T V.42 and MNP 2,3 and 4 error correction •57,600bps effective throughout •Auto speed negotiation •Adaptive line speed •Hardware and software flow control •Data communications, internet and fax software included.

5 YAER WARRANTY

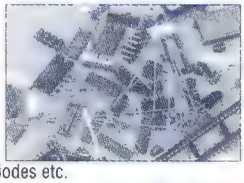
Cat. XM-5100 **only $199!!!**

FREECALL FOR PHONE ORDERS

008 022 888

Mixed Semi Pack

Contains a minimum 100 mixed semi conductors for $10. Includes ICs, transistors, diodes etc.



Cat. ZP-8990 **only $10**

SAVE $40 ON OUR TOP OF LINE AC + DC TRUE RMS DIGITAL MULTIMETER

FEATURES INCLUDE: •4000 COUNTS •40,000 COUNTS MODE •ANALOGUE BARGRAPH •DUAL DISPLAY •0.08% BASIC DCV ACC •BACKLIGHT DISPLAY •TRUE RMS •DC VOLTAGE •(DC + AC) VOLTAGE •DC CURRENT •AC CURRENT •RESISTANCE •CONDUCTANCE •FREQUENCY •DUTY CYCLE •CAPACITANCE •DC ADAPTOR •AC ADAPTOR •DBM & DB •DIODE •150US CONTINUITY •50MS RECORD •0.8MS CREST •SORT •DATA HOLD •STORE AND RECALL •RELATIVE ZERO •RELATIVE % CHANGE •RELATIVE PER UNIT •INPUT WARNING •SPLASH PROOF CASE •PROTECTIVE HOLSTER COMPLETE WITH TEST LEADS, BATTERY INSTALLED AND USERS MANUAL. SEE CATALOG FOR FULL DETAILS. CAT. QM-1460

1 Amp Regulated Switched Power Supply

Desktop type, with outputs of 6,9 and 12V DC. Includes 7 reversable plugs.

NEW

Cat. MP-3032 **only $39.95**

500mA Regulated 3/4.5/6/7.5/9/12VDC

Cat. MP-3030 **$29.95**

Panel Meter Sellout

MU65 style which is the largest available in the range. Overall size 100(W) x 82(H)

CAT PRICE $24.50 EA

Now $14.95ea

0-1MA Cat. QP-5040

0-100UA Cat. QP-5042

Headphone Extension Lead Bargain!!!

Limited quantity. These leads should have been curly cord, but they arrived straight. 6.5mm stereo plug to stereo plug line socket. Length 2.8 metres. Curly cord ones sell for 411.95. These are only $4.95

Cat. WA-1004 **only $4.95**

Car Speaker Kit

SAVE $50

These are a 2nd brand for famous name car speakers. Look at the name on the surround ring. Consists of a 6.5" woofer and a Neodidyium Super Tweeter and a high power crossover. They handle high power so need a high power amplifier. They sound excellent and we can't understand why they won't sell. At this months birthday price they represent an absolute bargain. See cat page 64. Specs: •Power handling: 80WRMS, 240WPMPO •Freq resp: 50-22kHz •Sensitivity: 90dB/W/1m **Cat. CS-2275**

Catalogue Price $199.50pr

Jan $149.50pr

Multiturn Pot Sellout

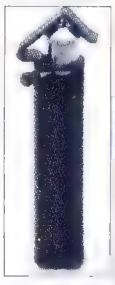
Quality Japanese Sakae Brand

These are 10 turn glass filled with phenolic base. Stainless steel 1/4" shaft with screwdriver slot. Linear tracks rated at 3W @ 40°C. Some types have extremely limited quantities with stock only in our stores. Normally worth around $14, some values are in our catalogue at $5.95 and $7.95. Grab these while we have them.

Cat. RP-3810	100Ω		
Cat. RP-3812	200Ω	Cat. RP-3814	500Ω
Cat. RP-3818	2KΩ	Cat. RP-3830	100KΩ

ONLY $3.95 each

PROFESSIONAL ADJUSTABLE WIRE STRIPPER SELLOUT



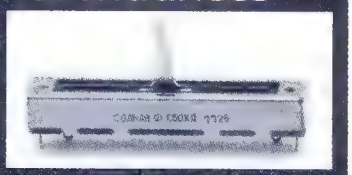
Quality tool ideal for stripping coaxial cables. Will either strip in a circular motion or slice the sheath side ways. Simple cutting depth adjustment. If you strip a lot of cables, this tool is a must for your toolbox.

Cat. TH-1822 **WAS $24.95**

NOW $10 SAVE$14.95

Slide Pot Madness

50K LOG 45mm Slider Pot. Soanar brand. 3mm slot for knob. Worth $2-$3.



Cat. RP-3910 **Cat Price $1**

JAN 20 FOR $5

300 Watt Sinewave Inverter Sellout

See 1995 catalogue P109 for full details.

CAT PRICE $699

January $550

SAVE $149 Cat. MI-5030

PRO Mic/Headset SALE!!!

See catalogue page 59 for full details.

CAT PRICE $89.95

Jan $69.95

SAVE $20

Cat. AA-2022

METAL DESOLDER TOOL

See cat page 88 for details.

NOW $12.95

WAS $16.95 SAVE $4 Cat. TH-1862

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SAVE BIG $$$$$ ON JV100 10" 3 WAY 5 SPEAKER KIT

Jaycar vifa

Huge Power Handling - Amazing Sound
See catalogue for full details or call into any Jaycar store for a demo.
Buy in January and save big dollars.

SPEAKER KIT
Normally $1199 pair
Jan $999 pair Save $200

FULL KIT WITH CABINETS
Normally $1499 pair
Jan $1250 pair Save $249

Quote from Leo Simpson Silicon Chip Magazine On JV100's
This speaker really performs, with prodigious power handling & beautiful bass down to below 30Hz. But as well as power handling & extended bass response, the system is very satisfying in its handling of all types of music with a smooth midrange & very clean treble reproduction.

100 Watt Inverter Sellout!!!

Convert 12VDC to 240VAC and run products up to 100 watts. See page 108 of catalogue for full details. Cat. MI-5035

1994 PRICE $134.95
1995 PRICE $89.50
Now Only $69.50

BUY 10 LESS 10%

PART CASES CLEAROUT!

SAVE

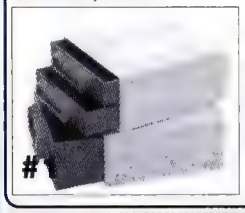
Prices reduced further.

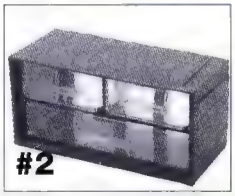
#1 - INTERLOCKING SINGLE PARTS DRAWER
Single or double drawers available. Size: 110(W) x 120(D) x 50(H)mm.
Cat. HB-6300 Was $5.95 Now $3.25 Save $2.70
Some double drawer units available in very limited quantities. Cat HB-6301 was $6.20 Now $4.20

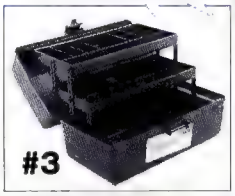
#2 - 3 DRAWER PARTS CABINET
Size: 98(W) x 42(H) x 88(D)mm.
Cat. HB-6323 Was $5.95 Now $3.25 Save $2.70

#3 - SMALL TOOLBOX
Has 2 compartment trays. Total size 310(L) x 160(W) x 150(D)mm.
Cat. HB-6330 Was $17.95 Now $13.95
Save $4.00

CLEAROUT PRICES







Travel World Clock Calendar

This travel clock has the following features; •it will show the times of 16 different cities, London, Paris, cairo, Moscow, Karachi, Bankok, Hong Kong, Tokyo, Sydney, Wellington, Honolulu, Los Angeles, Denver, Chicago, New York, Rio De Janeiro •has a 200 year perpetual calendar from 1900 to 2099 •real time clock with hour, minute and second display •12/24 hour format •alarm chime function •8 digit calculator •folding shell case, ideal for travelling.

NEW

Cat. QM-7282 **$19.95**

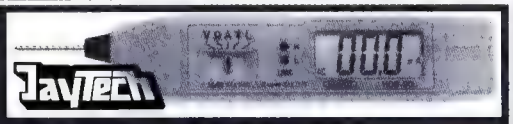
World Clock Calendar

Travelling overseas, and not sure whether to take summer or winter clothes! This will tell you. It shows the min and max temperature and number of rainy days for each month of the year for 24 cities. For example: December temperature range in Chigago is -7° to +1°C with 10 rainy days.
Cities are: Honolulu, Anchorage, Los Angeles, Denver, Chicago, New York, Toronto, Rio De Jeneiro, London, Paris, Berlin, Rome, Helsinki, Cairo, Moscow, Riyadh, New Delhi, Bankok, Singapore, Hong Kong, Beijing, Seoul, Tokyo and Sydney. But thats not all, there is an alarm and it has a 12 or 24 hour format.
Ideal for desks or to take with you on your trip. Colour is blue, with LED display. Supplied with tilting bail to stand up.

NEW

Cat. QM-7280 **$19.95**

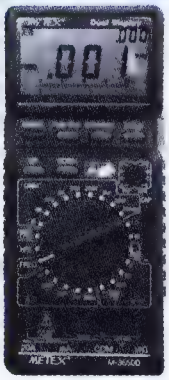
Save $10 on Probe DMM



•Logic test •Diode •Buzzer •Auto/manual range •Data hold. See 1995 catalogue P32 for full details. Cat. QM-1420

WAS $54.95 **Jan $44.95** **SAVE $10**

SAVE ON METEX RS232 DMM



•Dual display •RS232 interface •Transistor •Capacitance •Auto hold •Data hold •10 memory •Bargraph •Min/max display •Relative offset •Logic •20 amp •20mHz frequency See catalogue page 29 for full details.

Cat. QM-1240

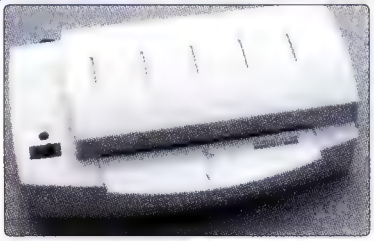
Cat Price $179.50
Jan $149.50!!
Save $30!!

SAVE SAVE SAVE ON NICADS!!!!!!

		NORMAL	JAN	SAVE	CAT
9 VOLT NICAD	100MA	$17.95	$14.95	$3	SB-2458
AAA - PKT 2	180MA	$6.95	$4.95	$2	SB-2454
C NICAD	1.2A	$5.95	$4.95	$1	SB-2459
C NICAD	2.25A	$9.50	$7.50	$2	SB-2464
D NICAD	1.2A	$5.95	$4.95	$1	SB-2460
D NICAD	5.1A	$16.95	$13.95	$3	SB-2466

SAVE!!

A4 LAMINATING MACHINE



Protect catalogues, documents, etc up to A4 size (216 x 303mm). Operates on 240VAC.
Save $50 For January

NEW

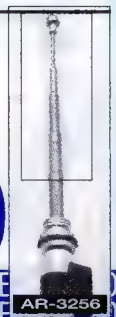
Opposition Price: $399
Jaycars Price: $299
JANUARY PRICE $249
Cat. XL-2510

A4 Laminating Sleeves Pkt of 25
Cat. XL-2512 **$24.95**

Jaycar ELECTRONICS

BUY A SPARE! LOCKDOWN ANTENNA FOR EA-EB FALCON

Cat. AR-3256 **was $14.95**
Save $4.95
now only $10



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More Kits

GEIGER COUNTER

REF: Silicon Chip September '95
Our Geiger Counter Kit will detect alpha, beta and gamma radiation and has an audible output. Kit includes PC Board, Case, Geiger Muller Tube, Speaker, Transformer Assembly and all specified components. Cat. KC-5194

normally $179.50 Save $20

ONLY $159.50

Jacobs Ladder High Voltage Display Kit

REF: Silicon Chip September 1995
Ever since scientists Telsla and Edison were able to generate really high voltages the Jacobs Ladder display has been creating awe. Best examples of a Jacobs Ladder can be seen in those early Frankenstein films, and the kit presented here produces a noisy ladder of sparks that look equally as nasty and dangerous - as indeed they are - along with the familiar smell of ozone! Kit includes PCB and electronic components. 12V auto coil required - not incl.

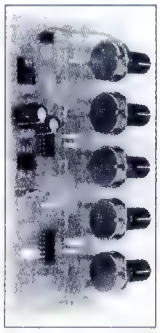
Cat. KC-5191 **$29.95**

5 Band Equaliser Kit

NEW

REFER: SILICON CHIP 12/95
Liven up your keyboard, guitar or music system with this low noise equaliser kit. Each band is centred on 63Hz, 250Hz, 1kHz, 4kHz and 16kHz with low distortion of .005% over the 20Hz to 20kHz range. S/N -97dB A-weighted @ 1VRMS. DC rectifiers and regulators on board - just add AC 30V C-T transformer use MM-2007. Two kits required for stereo. PCB, knobs and electronic components supplied.

Cat. KC-5197 **$39.95**

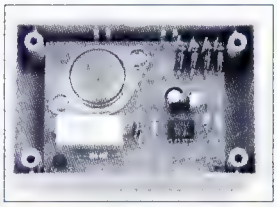


Engine Immobiliser Kit

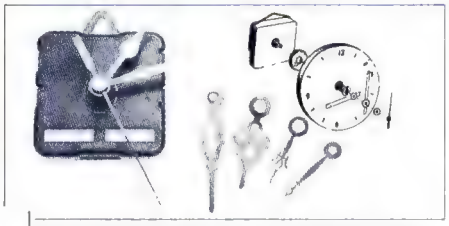
NEW

REFER: SILICON CHIP 12/95
This simple yet effective circuit will immobilise your car if a thief tries to start it, providing you with cheap insurance and peace of mind. The unit allows the engine to be started but stops after 3.5 seconds - repeatedly stalling the engine and frustrating the would-be-thief. After several tries the thief is likely to decide the car has an intermittant problem and leave it. PCB, case, auto connectors and components supplied.

Cat. KC-5196 **$24.95**



Clock Movement



MAKE YOUR OWN CLOCK! FIX YOUR OLD CLOCK!
•Very compact 56 x 56 x 15mm •Self starting one second stepping motor •Uses 1 x AA battery that lasts 1 year •±15 second/month accuracy •Supplied with three sets of hands •Includes sweep second hand

Cat. XC-0100 **$9.95**

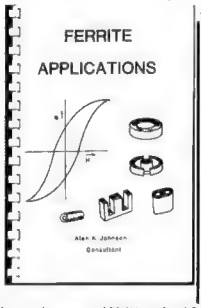
MELODY MOVEMENTS ALSO AVAILABLE
Cat. XC-0106 Westminster Chimes **$21.50**
Cat. XC-0107 12 Melodies **$21.50**

SW/AM/FM MINI RADIO

Listen to the world. Features AM/FM and shortwave band (3.1 to 17.6MHz). Measures only 125(W) x 70(H) x 28(D)mm. Features include: LED band indicators, feather touch selector, micro size, telescopic FM-SW antenna, carry strap, earphone jack. Operates on 2 AA batteries. Bargain price.

Cat. AR-2200 **Cat Price $42.95**
JANUARY $29.95 Save $13

Ferrite Material & Applications



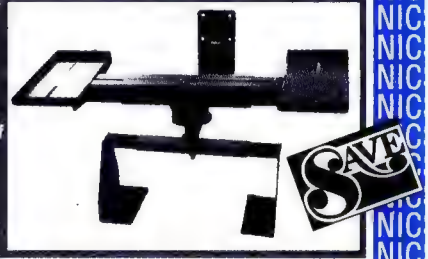
This is one subject that is very difficult to find any information on. Magnetic cores are the foundation for transformers, inductors and chokes used in so many of our electronic projects. This book is intended to be used by persons who want to (or have to) work with ferrite materials, but are not well versed in magnetics or ferrites and cannot justify outside consultation. Some of the problems addressed are:- • How to select the right type of material • How to identify an unknown material • How to measure material properties and much more. Written in 1991 by A. K. Johnson. Softcover, ringbinder. 82 pages 212 x 132mm.

Cat. BC-1125 **Cat Price $18.95**
JAN $12.95 Save $6

TV Wall Bracket with VCR Shelf

The VCR shelf attaches firmly underneath the platform, so that both the TV and VCR controls are close together. Finished in black epoxy polyestor powder coating. The TV shelf expands width wise from 380mm to a massive 1150mm. Depth of shelf 260mm. VCR shelf expands from 350mm to 540mm. Load capacity is 50kgs. Cat. CW-2830

1994 Price $79.95 1995 Price $79.95
NOW ONLY $59.95

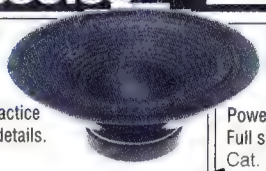


Speaker / Microwave Wall Bracket

This bracket will accomodate a large range of things including speakers, microwave ovens, clothes dryers etc. The shelf has an adjustable depth from 375mm to 570mm, wall bracket length is 420mm maximum. Ffinished in black. Load capacity is 31kgs.

Cat. CW-2820
1994 Price $37.50 1995 Price $29.95
NOW ONLY $20 SAVE $$

Save $10 on 10" Guitar Speaker



Power handling 65WRMS. Ideal for practice amp. See 1995 catalogue P50 for full details.

CAT PRICE $57.50
Jan $47.50 SAVE $10
Cat. CG-2376

12" 4Ω Polycone Jaycar RESPONSE Woofer

Power handling 200WRMS. Full specs see cat P63.

Cat. CG-2238
WAS $135
Jan $99
SAVE $36

Polyswitch Speaker Protectors

Save Money and protect your speakers. See cat P51 for details.

Cat no	Part No	Price	Jan Special	Save	Trip Watts 4 ohms	Trip Watts 6 ohms	Trip Watts 8 ohms
RN-3460	RXE075	$6.95	$4.95	$2.00	5.1	7.7	10.2
RN-3462	RXE090	$7.25	$4.75	$2.20	7.3	10.9	14.6
RN-3464	RXE110	$7.50	$5.20	$2.30	10.9	16.3	21.8
RN-3466	RXE160	$7.95	$5.50	$2.45	23.0	34.6	46.1
RN-3468	RXE185	$8.50	$5.50	$3.00	31.4	47.0	62.7
RN-3470	RXE250	$9.95	$6.95	$3.00	56.3	84.4	112.5
RN-3472	RXE300	$10.95	$7.50	$3.45	81.0	121.5	162.0
RN-3474	RXE375	$12.95	$8.95	$4.00	126.8	190.2	253.6

Plug In Rabbit Ears Antenna

Ideal replacement. Has two telescopic antennas in plastic base that plugs into a socket on the TV for mounting. Supplied with length of 300Ω cable and spade terminals. Antenna rods are adjustable and expanded length is 800mm. Surplus buy - priced well below normal.

Cat. LT-3120 **$4.95**

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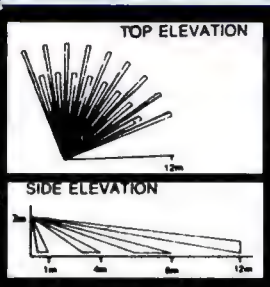
SAVE

PIR MADNESS!!!

NEW

We have made a scoop purchase of a quantity of Micron Pulse count passive infrared detectors. The Micron PIRs are designed by an English company and manufactured in Asia. This unit is currently being sold to the installer market, at a price which is higher than what we can offer you. But remember, this is a once only deal, and cannot be repeated. Stock will not last.
The Micron is the ultimate low cost/high performance PIR detector. The Micron circuit design has been tested at 20V/m over the frequency range 20 to 1000MHz proving that the Micron has ultra high RFI protection and complies with BS6667, part 3 and IEC Publication 801, Part 3. Knowing the Micron has passed these tests and by utilizing the selectable 1,3 or 5 pulse count, once installed correctly you can leave the installation, confident that false alarms will not occur.Specifications: •selectable 1, 3 or 5 pulse count •operating voltage 9-16VDC •current 17mA •alarm contacts - NC •operating temp -10° to 55°C •pyroelectric detector dual element.



NORMALLY WOULD COST AROUND $35 TO $40 Cat. LA-5030 **ONLY $25 OR 10 FOR $200**

HOME BURGLAR ALARM DEALS FROM JAYCAR

Protect Your Home For Under $200

You won't beat this deal anywhere. Checkout what our opposition have available for $249!!! All you need is a bit of labour and you have a reliable affordable alarm that offers you piece of mind.

INCLUDES:	NORMAL PRICE
1 x 4 sector Jaytech panel	$109.50
2 x Jaytech pulse count PIRs	$59.90
1 x mains power supply	$21.50
2 x reed/magnet switches	$11.50
1 x siren horn	$24.95
2 x deterrent stickers	$4.00
50 m of 4 core alarm cable	$28.00
NORMALLY PAY	$259.35

Cat. LA5450 **Pay Only $199**

Ideal for larger homes. This system has our 6 sector panel and includes everything that a professional alarm installation company would install and charge around 800-$1000. Save a fortune by doing it yourself.

INCLUDES:	NORMAL PRICE
1 x 6 sector Jaytech panel	$139.50
1 x mains power supply	$21.50
1 x 1.2Ah backup battery	$28.50
3 x Jaytech pulse count PIRs	$89.85
3 x reed/magnet switches	$17.25
1 x strobe	$19.95
1 x metal siren cover	$28.95
1 x siren horn	$24.95
1 x internal siren	$19.95
2 x deterrent stickers	$4.00
100 m of 6 core alarm cable	$88.00
NORMALLY PAY	$482.40

Cat. LA5455 **Pay Only $349**

This system inculdes the brand new DSC 5 sector alarm panel with Austel Approved dialler. Connect it to an alarm company or it can phone you or your neighbours etc.

INCLUDES:	NORMAL PRICE
1 x DSC 5 zone alarm/dialler	$279.00
3 x Bellmate 100 PIRs	$119.85
1 x mains 3 wire power supply	$24.95
1 x 6.5Ah backup battery	$43.50
2 x reed/magnet switches	$11.50
1 x strobe	$19.95
1 x metal siren cover	$28.95
1 x siren horn	$24.95
1 x internal siren	$24.95
2 x deterrent stickers	$4.00
100 m of 6 core alarm cable	$88.00
NORMALLY PAY	$669.60

Cat. LA5460 **Pay Only $599**

SAVE

ALARM CABLE BARGAIN

4 CORE ROUND

NORMALLY $56 PER 100M ROLL
JAN $29/roll Cat. WB-1590

6 CORE ROUND
NORMALLY $88 PER 100M ROLL
JAN $45/roll Cat. WB-1592

LAST CHANCE - Burglar Alarm Window Tape & Blocks

Are discontinued. Grab the last of our stocks while they last!!!

TAPE - 33M ROLL Cat. LA-5050
WAS $19.95 NOW $16.95

TERMINAL BLOCKS
For joining tape to alarm wiring.
WERE $1.25EA NOW $1ea
or 10+ 90¢ Cat. LA-5060

BULK USERS

CONTACT OUR WHOLESALE DEPARTMENT FOR SPECIAL PRICING
(02) 743 5222

Jaytech Digital Capacitance Meter

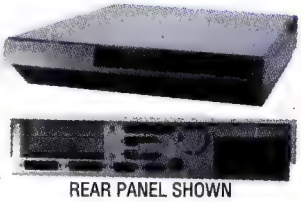
BRAND NEW MODEL!!! Has a unique tilting LCD display which allows you to read at any angle. General specs: •Display - 3.5 digit LCD •Range - 9 ranges 200pf to 20mf •Sampling time - 0.5 seconds •Accuracy - 0.5% ranges 200pf to 200mf ranges, 1.0% rang 2,000uf, 2.0% range 20mf.

NEW

Cat. QM-1572 **$99.50**

BARGAIN COMPUTER CASE

Limited quantity. It consists of a metal base/rear panel and fawn coloured plastic top and sides. It measures 360(D) x 340(W) x 70(H)mm. There is a slot in the front panel (26H x 216W) which will accept 2 x 3.5" disk drives or hard disks. Brackets supplied for mounting. The rear panel has numerous cutouts for a myriad of things. These include D25 slot for printer, D25 slot for COM2, D25 slot for SCSI, D37 slot for ext floppy disk, round hole for keyboard, reset pushbutton hole, slots for fan, hole for expansion board 112W x 47Hmm and a hole for a power supply 86W x 53Hmm. Grab one while we have them.Mail order customers add an extra $4 to P&P charges due to heavy weight (3kgs).



REAR PANEL SHOWN

Cat. HB-5100 **only $10**

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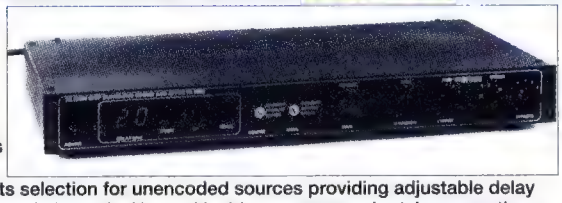
JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

NEW KIT

DOLBY PRO LOGIC SURROUND SOUND DECODER & EFFECTS KIT

ONLY AVAILABLE FROM JAYCAR

REF: SC Nov/Dec 95



You don't have to go to the cinema for big movie sound - you can get it right here with this genuine Dolby Pro Logic Decoder kit! This new design features inbuilt power amplifiers to drive the centre and surround channels and an effects selection for unencoded sources providing adjustable delay between the front and rear surround channels. Housed inside a custom rack-style case, other features include auto noise sequencer for balance setup, sub woofer output, adjustable delay from 15mS to 30mS and a 2 digit front panel delay display. This design has been fully approved AND tested by Dolby Laboratories in the USA. Kit is complete with punched and screened steel chassis, toroidal transformer, microprocessor and all specified electronic components as per the Silicon Chip article.

DOLBY SURROUND PRO • LOGIC

Cat. KC-5200 **ONLY $379.00**

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Yes, you can now buy the Dolby Pro Logic short form kit (KC-5175) and the enclosure kit (KC-5176) for $199.

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NEW KITS

ESR & Low Ohms Meter Kit

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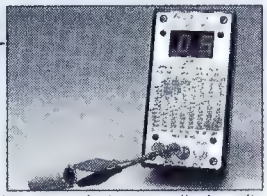


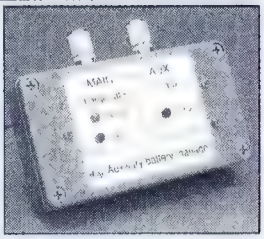
REFER: EA JANUARY 1996

If you repair switch mode power supplies, TV receivers, computer monitors, vintage radios, audio power amplifiers etc then you owe it to yourself to give this project serious consideration. It measures an aspect of elctrolytic capacitor performance which is VERY IMPORTANT BUT NORMALLY VERY DIFFICULT TO CHECK the equivalent series resistance, or "ESR". A standard capacitance meter won't help too much in finding faulty electros as an electro normally doesn't lose its capacitance - as many techs assume they do (see EA January 1996 for a full explanation). The ESR value is displayed on two 7 segment LED displays, and a chart printed on the front of the case for easy reckoning. Kit is complete with case, silkscreened front panel, PCB, pre-programmed microprocessor plus all electronic components. 9V battery required.

Cat. KA-1783 **$69.50**

Smart Dual 12V Battery Controller Kit For 4WDers

NEW



REFER: EA JANUARY 1996

The main advantage of an auxilliary battery powering any "non-essential" accessories such as a refrigerator during an overnight stop, is that the main battery is preserved for starting the engine in the morning.

This kit will automatically isolate the auxilliary battery during stops, but connect it to the main 12V system for charging while the engine is running. The circuit is housed inside a robust weatherproof diecast case that could be mounted inside the engine bay. Case, PCB, heavy duty battery binding posts plus all electronic components included.

Cat. KA-1782 **$44.95**

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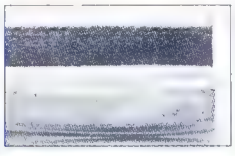

Ideal for cars and houses, and can be laid under carpets - its only 2mm high. 7 x 48/0.1mm. See 1995 cat P156 for full details. Cat. WB-1738

CAT PRICE $5.95 METRE

Jan $3.95m or $350/100m roll

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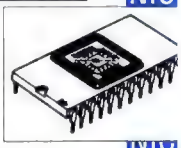
27C128	EPROM	ZZ8469	$9.95	$6.95
27256	EPROM	ZZ8470	$11.95	$7.95
27C512	EPROM	ZZ8474	$11.95	$7.95
D41264C	RAM	ZZ8520	$8.95	$4.95
P8086-2	5mhz CPU	ZZ8510	NA	5 for $5
SN75477P	Dual Driver	ZK8865	NA	10 for $4
4116 USED	RAM	ZZ8419	NA	20 for $5



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CAT PRICE $59.50

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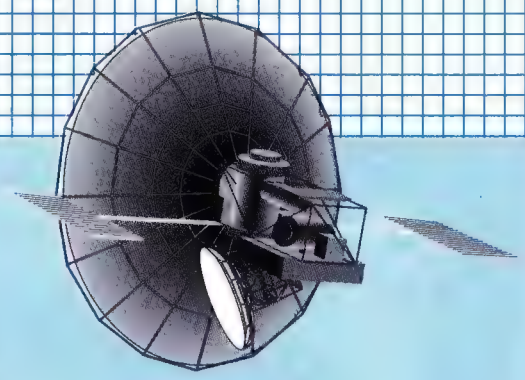
SATELLITE WATCH



Welcome to the first Satellite Watch column, where we will keep you updated with satellite signal reception reports for Australia and NZ.

Compiled by GARRY CRATT*

• **INTELSAT – 70-66° E longitude, C band:** This satellite is visible only from the west coast of Australia and carries Worldnet programming from the USA, CFI from Paris and various other itinerant signals.

• **GORIZONT – 19 - 96.5° E longitude, C band:** This satellite carries the Russian "Network 1" programming on 1475MHz, with audio at 7.02MHz. An additional radio service is also carried at 7.5MHz. CCTV 4 Chinese television can be seen at 1325MHz and now carries a new English News service. Az Tv from Azerbaijan can be seen on an irregular basis at around 1800AEST and can be found at IF 1425MHz.

• **ASIASAT II – 100.5° E longitude, C band:** Scheduled for launch last November, this will provide new programming for satellite enthusiasts. After months of delay caused by previous failures aboard the Long March launcher, this is the launch that will make or break Great Wall. Mooted to carry similar programming to ASIASAT I, this satellite will be visible over Australia and New Zealand with a small (2m) dish. At least five channels will be free to air, according to prelaunch press releases.

• **GORIZONT 25 – 103° E longitude, C band:** Another Russian satellite carrying Network 1 programming, for a different time zone to Gorizont 19.

• **ASIASAT 1 – 105.5° E longitude, C band:** Visible in the northern and north western parts of Australia, this satellite has a potential northern hemisphere audience of over a billion viewers and covers from India to the Middle East. Reports as far south as Albury (NSW) and the Barossa Valley area indicate sidelobe signals are visible in some parts of southern Australia. Programming carried includes Prime Sports, Star Movies, Zee TV and other pay services. Transponder frequencies can be obtained by dialling the Hong Kong Info service number: 0011 852 172 777 01. Call charges are at normal IDD rates.

• **PALAPA B2P – 113° E longitude, C band:** Presently visible only in the Northern part of Australia, this satellite was placed in an inclined orbit in November, to conserve station keeping fuel, whilst waiting the launch and subsequent replacement by PALAPA C1, a higher powered satellite covering all of Australia and New Zealand. Palapa C1 will now be launched by Lockheed Martin of the USA. Prior to this announcement in October, the launch was scheduled with Ariannespace but the launch company was unable to keep to the original schedule.

It is expected that all current users will transfer to the new satellite, now scheduled for launch in January 1996. Amongst signals on the B2P satellite is Australia's ATVI, the international arm of the ABC. Weekly program data can be obtained by polling fax # 055 29900.

• **JCSAT 3:** First observed early in October, this satellite has the capability to cover Australia and New Zealand with strong signals. Reports from the east coast of Australia, Japan, Hawaii and Noumea indicate the testing phase of this satellite is almost complete. It is expected that some programming could become available early in 1996.

• **RIMSAT G1 – 130° E longitude, C band:** The orbit of this Russian Gorizont class satellite is only slightly inclined, making 24-hour small dish reception of RAJ TV, a Tamill language broadcast, a reality. RAJ TV operates at 1475MHz.

• **RIMSAT G2 – 142.5° E longitude, C band:** Until September 12, this satellite carried the ATN network from India. Due to unresolved difficulties involving the satellite operator RIMSAT, the Russian government space agency and ATN, this transponder ceased operations temporarily during September but now appears to be operating on a permanent basis. The other full time transponder, operating at 1265MHz, carries EM TV from Papua New Guinea. This transponder operates LHCP (left hand circular polarisation) and carries a mix of Nine network (Australia) and local programming.

During late November, ATN changed format to two adjacent half transponders. Whilst continuing with the regular ATN broadcasts on IF 1465MHz, ATN PRIME will commence early December using an IF of 1480MHz.

• **OPTUS B1 - 160° E longitude, K band:** This satellite carries outback TV in BMAC, as well as up to five interchange services in PAL. Interchange IF frequencies are: 1219, 1155, 1425 (all vertically polarised) and 1249MHz horizontal.

• **OPTUS B3 – 156° E longitude, K band:** The latest Optus satellite came into operation last August. Presently, it carries several closed user group BMAC services, as well as the OTEN network (Victorian and NSW education departments) and several interchange services. IF frequencies are 1233, 1361 and 1094MHz. The Optus A3 satellite, until recently co-located at 156° E, is most likely part way through a planned drift back to 164°, where it could be used to replace the ageing A2 satellite, now in an inclined orbit.

• **PANAMSAT PAS-2 – 169° E longitude, C band:** Although many services on this bird use either secure BMAC or MPEG 2, there are still some analog services that can be viewed by enthusiasts. CNN, NHK and CNBC Asia operate on 1153, 1113 and 1035MHz IFs. Recent itinerant users include the American ABC network and a number of news feeds from Osaka, Japan, during the recent ASEAN conference.

• **INTELSAT 511 – 180° E longitude, C band:** This ageing satellite, now in an inclined orbit but due to be replaced during 1996, carries Deutsche Welle programming from Germany, RFO from Tahiti and Worldnet from the USA. In the last few months several services have migrated from Intelsat to other satellites, whilst some previous analog services (CNN, NBC) have gone to digital format. **SC**

*Garry Cratt is Managing Director of AvComm Pty Ltd, suppliers of satellite TV reception systems.

Rain Brain

By GRAHAM BLOWES

This automatic sprinkler controller allows you to selectively water any area of a garden or nursery as little or as often as you like. It can control up to eight solenoids plus an optional master solenoid.

THE FIRST VERSION of this design was published in the July 1992 edition of SILICON CHIP. It was a popular project and I still get enquires from the original article.

About a year ago, I decided that an update was due. The most obvious thing that needed replacing was the microcontroller, as the NMOS 68705-P3 microcontroller was to be discontinued. The controller now uses a PLCC version of the popular 68HC-705C8. There was also some changes made to the power supply, which now uses a switching IC.

While I was at it, I also decided to make a couple of changes to the front panel layout. First, I deleted the row of green LEDs that were used to indicate which solenoids were on. This function is now taken care of by the row of red LEDs – when a solenoid turns on, the appropriate LED flashes at a fast rate to provide the "on" indication.

I also added an extra button to the front panel to make it easier to get back to the default mode. Apart from that, the layout of the front panel worked pretty well, so I kept it that way.

The PC board is also now a lot easier to put together than before. And finally, I've added three inputs – designated Rain 1, Rain 2 and Frost 1 – that enable almost complete automation of your garden!

Two of the inputs are for optional rain switches that enable the controller to turn off selected cycles if it is raining. This facility is especially important in a country like Australia, where many parts of the country suffer from low rainfall. Wasting water costs money, especially these days with the in-vogue user-pays principle, so turning off the sprinklers when it rains makes economical (and ecological) sense.

The third input is for a temperature sensor (again optional). This enables the controller to switch in extra cycles on a hot day. It even works in reverse; an extra cycle can be switched in if the temperature falls below a set trip point. The controller even stores the MIN and MAX temperatures (time stamped) for today and yesterday.

Each rain switch and temperature trip point can be set on a cycle by cycle basis. The default mode can display the time and date, or the time and current temperature. This facil-

Main Features

(1). Uses a 16 x 1 liquid crystal display (LCD) to show time, date and sprinkler settings, plus all the various system menus.
(2). Controls up to eight solenoids plus a master solenoid.
(3). Each station can have up to four cycles on Program A and Program B, or eight cycles on Program C (Program C = Program A + B). Each cycle can operate with either the three-week built-in calendar or on a continuous schedule for up to 99 days
(4). Each station (and cycle) is completely autonomous, providing a possible 64 programmable start times per day (Program C).
(5). LED indication of station status. Continuously lit = auto mode on; fast flash = solenoid on; 1Hz flash = Rain Off mode.
(6). Manual on/off control for each solenoid. The run time of cycle 4 can be used to provide an automatic cut-off feature. This lets you manually switch on a sprinkler and forget it. The sprinkler will then automatically turn off after the run time of cycle 4 has expired.
(7). Run time (per cycle): 1-99 minutes. The cycles can be joined so the maximum run-time (per solenoid) is: 8 x 99 minutes = 13 hrs, 10 mins.
(8). An EEPROM stores all settings, so settings are not lost if the backup battery fails. Battery backup is provided by a 3V lithium battery.
(9). A "Rain Mode" deactivates all automatic cycles while saving program settings.
(10). Two fully programmable Rain Switches (optional) allow any/all of the 64 cycles to be controlled by the immediate weather conditions automatically.
(11). An optional Temperature Sensor enables any/all of the 32 cycles of Program A (or B) to switch to another cycle if the programmed trip temperature is exceeded. This allows extra cycles to be automatically added; eg, so that plants get extra water on a hot day! The sensor is accurate to ±0.1°C and has a range from -20°C +60°C.
(12). The controller stores the maximum and minimum temperatures sensed that day and the time at which these extremes occurred is also recorded. This information is accessed by pressing the "Cursor" button while in the Default Mode. The previous day's temperature extremes can also be displayed, as well as the current temperature!
(13). Uses the well proven MC68HC-705C8 microcontroller. A watch dog circuit ensures a proper reset is issued to the microcontroller if it "crashes" due to a mains glitch.
(14). All appropriate solenoids are enabled and the various cycles completed after a reset, or when power is restored after a power failure.
(15). Runs from a 10-24VAC or a 10-35V DC 1A plugpack supply.

ity is programmable via the "CONFIG" menu. More about that later.

Main features

The original version allowed sprinklers to turn on every day, every second day, every third day, etc. While this system worked OK, it was a bit difficult to nail down exactly which days the sprinklers would turn on. To rectify this, the Rain Brain now has a 3-week cycle as well as the original method – the original method being useful for plants that require watering at a set interval, regardless of whether it is a weekend or not.

The "3-week cycle" method is based on a built-in calendar. It lets you choose exactly which days the sprinklers will turn on up to three weeks in advance! For example, you could program the unit so that solenoid 1 turned for two 1-hour cycles on Monday of the first week, Wednesday of the second week and Thursday of the third week.

All the facilities mentioned above are available to every single cycle, and are programmable via the "AUXILIARY FUNCTIONS" menu.

To cater for the extra facilities, the Rain Brain has twice the EEPROM capacity of the previous version. Each of the eight stations can switch on as often as eight times a day (ie, there are up to eight daily cycles), or as little as once every 99 days! As before, each cycle can be programmed for an "on time" of 1-99 minutes.

A new feature allows you to choose from three standard programs, designated A, B and C. Programs A and B allow each station to programmed for four cycles per day, while program C combines programs A and B to provide up to eight cycles per station per day. If this isn't enough, you can add optional extra memory plus a switch to select an alternative group of A, B and C programs.

The row of eight LEDs beneath the LCD indicates the status of the solenoids at a glance. If a LED is flashing quickly, this indicates that the solenoid is turned on. If a LED is steady, the station is active, meaning that it will switch on automatically once its "turn on" conditions are satisfied. And if all enabled LEDs are flashing slowly (1s on, 1s off), a rain switch has been activated.

A flash rate of 0.5s on, 0.5s off indicates the "RAIN OFF" mode. This means that all automatic cycles have been globally disabled (see later). This mode has precedence over the rain switch inputs and the fast flash rate has precedence over them all.

Although these different flash rates may seem initially confusing, it all makes perfect sense when you start using the unit.

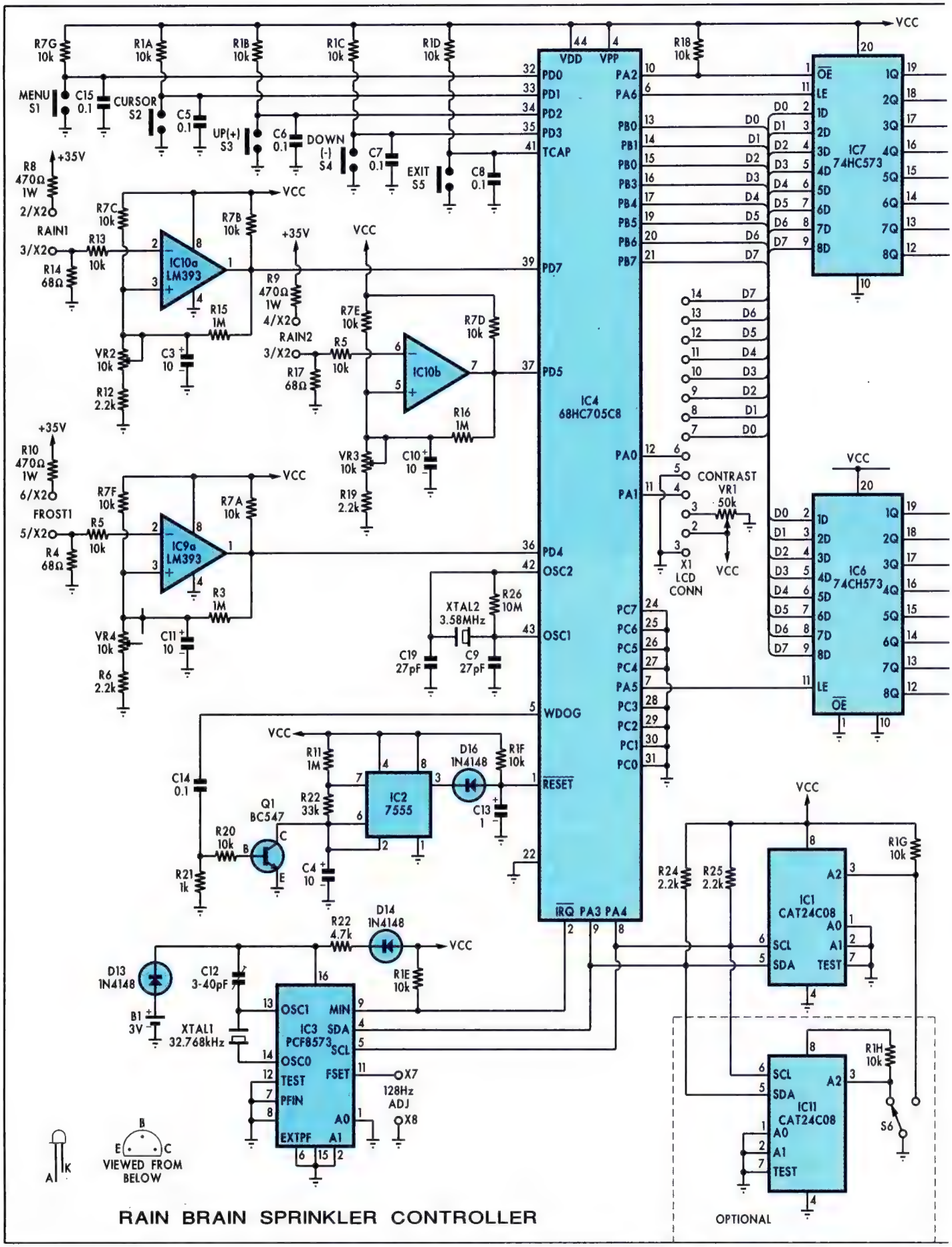
Power requirements

The unit is powered by the usual 24V AC plugpacks associated with watering systems, or from voltages as low as 10V DC. As with the first version, flat batteries are not a problem, as all settings are stored securely inside an EEPROM. The controller reads the EEPROM when it is first turned on, so it knows exactly which mode it should be in (RAIN OFF or DEFAULT) and which sprinklers are active.

Other uses

By this stage, you are probably already thinking of other uses for this versatile controller, apart from its primary use as a sprinkler solenoid controller. For example, those of you who have an interest in satellites can set the controller to switch on a tape recorder at the time it is due to pass overhead, even though you may be on holidays for a few weeks.

Alternatively, the unit could be used as a security light controller or


RAIN BRAIN SPRINKLER CONTROLLER
IC4 68HC705C8
IC10a LM393
IC10b
IC9a LM393
IC2 7555
IC3 PCF8573
IC1 CAT24C08
IC11 CAT24C08
IC6 74CH573
IC7 74HC573
MENU S1
CURSOR S2
UP(+) S3
DOWN (-) S4
EXIT S5
RAIN1 3/X2
RAIN2 3/X2
FROST1 5/X2
CONTRAST VR1 50k
X1 LCD CONN
XTAL1 32.768kHz
XTAL2 3.58MHz
B1 3V
X7 128Hz ADJ
X8
S6
Q1 BC547
D13 1N4148
D14 1N4148
D16 1N4148
VIEWED FROM BELOW
OPTIONAL
VCC

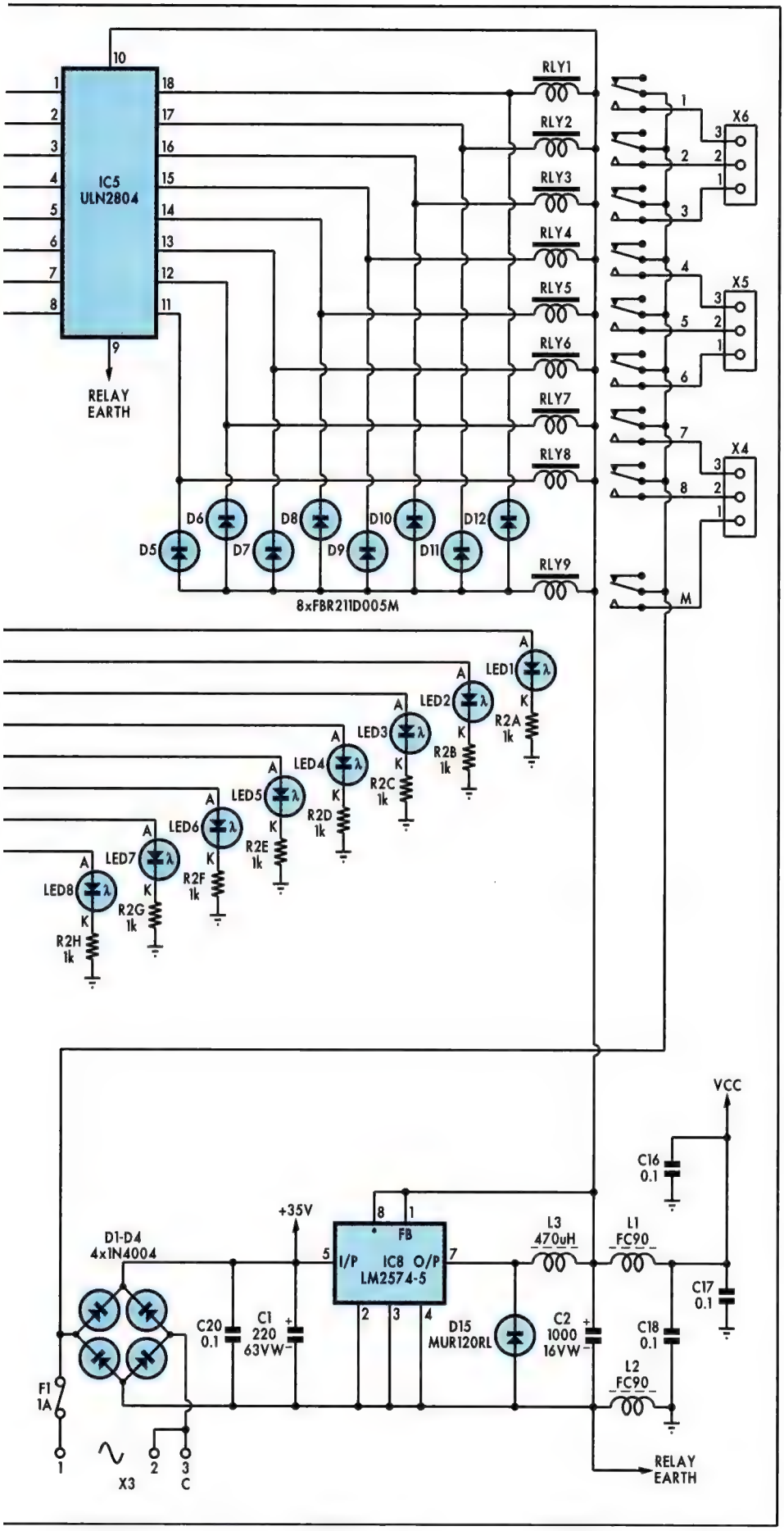


Fig.1 (left): the circuit is based on IC4, a 68HC705C8 microcontroller. IC3 is a real-time clock (RTC), while IC1 is an EEPROM and is used to store the programmed settings.

as a general-purpose timer. In these applications, the on-board relays can act as slaves to appropriately rated off-board relays, so that other equipment can be controlled.

How it works

The circuit is fairly straightforward (Fig.1), with all the heavy work being done by the software in the microcontroller (IC4).

Starting with the power supply, diodes D1-D4 rectify the 24V AC input, which results in about 35V DC across C1. IC8 (LM2574-5) is from the "simple switcher" series from National Semiconductor and provides a very efficient method of providing a 5V rail to power the circuitry.

The resultant 5V across C2 is further decoupled by L1 and L2. These inductors attenuate any spikes generated by the solenoids as they switch on and off. Note that the relay driver (ULN2804, IC5) is supplied from the "noisier" 5V across C2.

C16, C17 and C18 are spread around the PC board to decouple the power supply. The circuit draws the following currents from a 24V AC plugpack under the following conditions: (1) all LEDs off = 26mA; (2) all LEDs on = 32mA; and (3) all LEDs and relays on = 88mA.

The microcontroller (IC4) uses a standard 3.58MHz crystal (Xtal2) as a timebase. A feature of this microcontroller is an internal watchdog function, called the Computer Operating Properly (or COP). I tried to get this to work but the maximum timeout period with this crystal is a bit over one second. This is a bit short and I eventually opted for a tried and tested alternative built around timer stage IC2.

The time function is supplied by real time clock stage IC3 (PCF8573), hereafter referred to as the RTC. This RTC chip interrupts the microcontroller every minute. Each time it receives an interrupt, the microcontroller reads the RTC and stores the time in an internal RAM buffer.

After this, it reads 12 bytes of

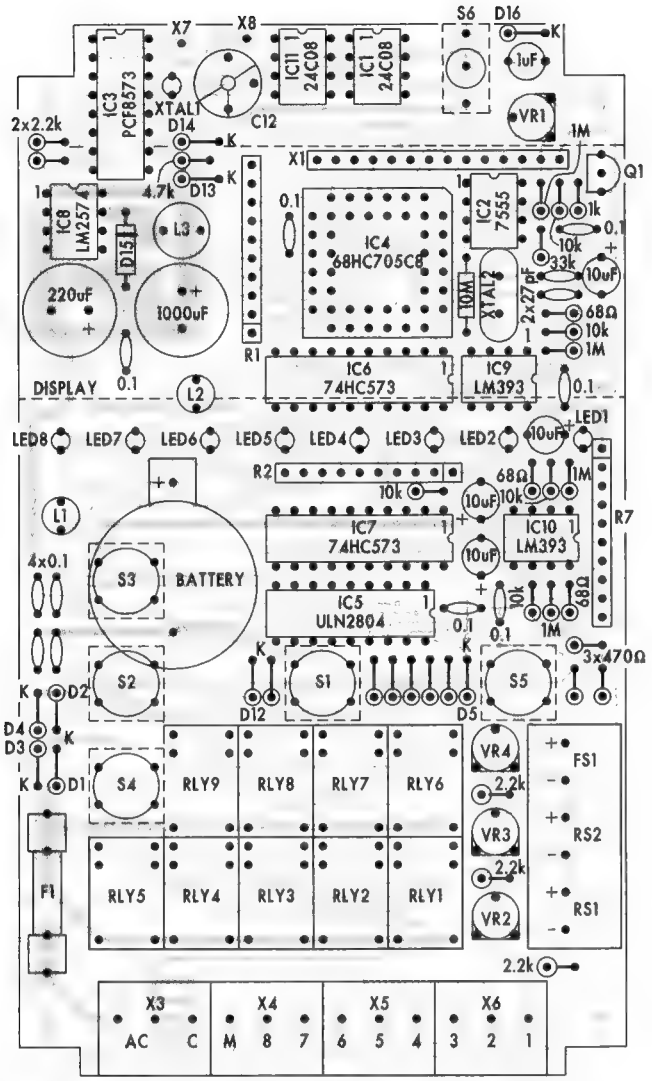


Fig.2: install the parts on the PC board as shown here. Note that IC1, IC3, IC4 & IC11, the relays and the LCD should not be mounted until after an initial "smoke" test has been carried out (see text).

EEPROM (IC1 or IC11) associated with cycle 1 of solenoid 8 and compares the stored start times with the current time and date. It then repeats the process 31 more times for the other cycles and solenoids (this process takes twice as long when program C is selected).

The LCD and the two 8-bit latches IC6 & IC7 (74HC573) share port B as a common data bus. When the microcontroller needs to send data to either latch, pin 11 of the required latch is pulsed high (by either PA5 or PA6). At reset, all port pins are initialised as inputs (high Z), therefore the OE pin (pin 1) of IC7 is held high by R18 until the latch is cleared and PA2 is made an output. This stops inadvertent operation of any relays until initialisation is complete.

The LCD data is validated by the E pin (pin 6, LCD connector). As the microcontroller is not required to read the internal RAM of the LCD display, the R\W pin can be tied low, which is write mode. VR1 is used to adjust the contrast of the display.

The two Rain Switch inputs (PD7 & PD5) are tested during the timer interrupt routine. Appropriate flags are set if any of these inputs are activated. The temperature input (PD4) is read every minute, for one second exactly. During this time, writes to the LCD and LED flashing routines are disallowed, so as to prevent incorrect temperature measurements.

Button switches

The button switches are connected directly to the microcontroller (PD0-PD4 & TCAP). An RC network attached to each pin provides a small amount of debounce, while the software does the rest.

Buttons S1-S4 (Menu, Cursor, Up, Down) are polled during the main loop, whereas button S5 (Exit) is connected to the TCAP input. The TCAP pin is an interrupt pin associated with the internal timer function. In this application, it is simply used to notify the microcontroller that the button was pressed in a manner similar to how a normal interrupt would be used.

Watchdog timer

This circuit comprises a CMOS 7555 IC (IC2), configured as an astable multivibrator but normally prevented from oscillating. If IC4 is functioning correctly, PA7 (pin 5) is set to a logic 1 within the timer interrupt routine and cleared in the mainloop. The resulting waveform continually charges and discharges C14. This means that Q1 is continually turned on and off, which prevents C4 from charging up and thus disables IC2.

However, if the pulses from PA7 stop due to a spike causing the program to stop and/or crash, IC2 will begin to oscillate. After about 10 seconds, its pin 3 output will pull IC4's reset pin (pin 1) low via D16, thereby resetting the microcontroller. Note that the time-out period is set to 10 seconds to allow for the "dead time" during the EEPROM read cycle every minute. The timer interrupt interval is set to 5ms.

The EEPROM

The EEPROM is an 8Kb device, internally organised as 1024 x 8 bits. Each cycle of each solenoid is allocated 12 bytes of the EEPROM (11 of these are used, with one spare). Another part of the EEPROM is set aside for storing "global" variables like the current year, the LED status, and whether "Rain Mode" is active or not.

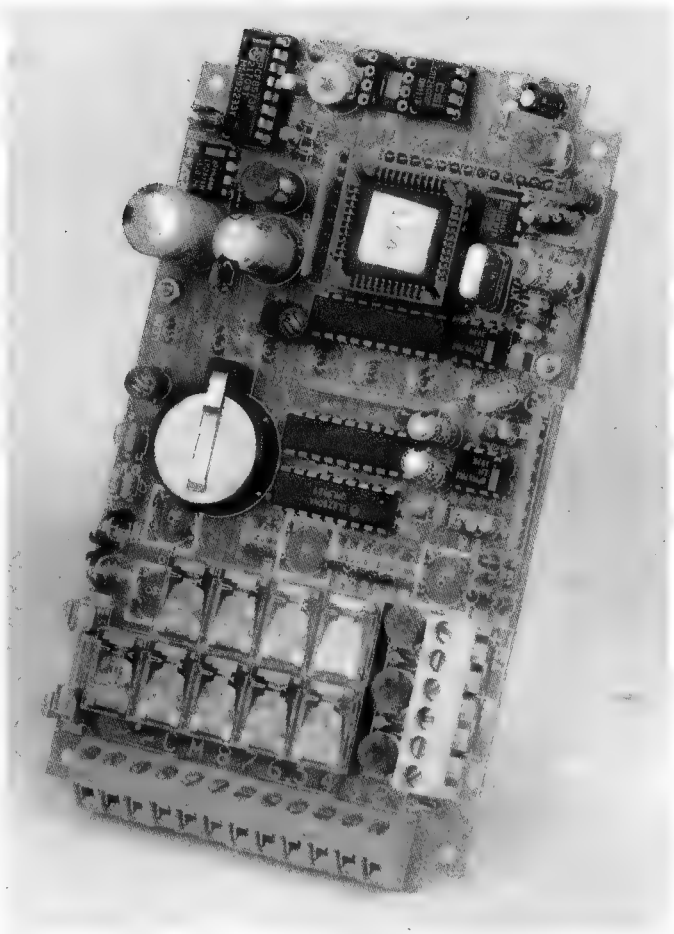
Pin 3 (A2) of IC1 and IC11 is an address pin, which allows two of these chips to be connected onto the same I^2C bus. The A2 pins are connected to either side of S6, which allows either of the EEPROMs to be switched into circuit.

The selected EEPROM is read at power up, to determine which mode it should be in (ie, "RAIN OFF" mode or just the Default mode) and which LEDs are active. At the next interrupt from the RTC (IC3), any cycle that satisfies the "On Time" conditions will be switched on. No settings will ever be lost!

Real time clock

The RTC chip (IC3) interrupts the microcontroller every minute, causing it to read the time. IC3 requires a 32.768kHz crystal (commonly called a "watch" crystal) for its internal dividers. The oscillator can be trimmed using C12 to provide very accurate time keeping. Note

The switches, the eight station indicator LEDs and the LCD are all installed on the reverse side of the board.



The programmed data in the EEPROM is backed up by a 3V lithium cell. Take care with the orientation of IC4.

that the FSET pin (frequency SET) is brought out to a PC board pin to facilitate easy tuning using a frequency meter.

When power is lost from the main circuit, a 3V lithium battery (B1) cuts in and keeps IC3's oscillator going. The battery is held off via D14 and D13 when normal power is applied to the circuit. IC3 draws about 7µA when the power is off.

Note that if the HOURS or MINUTES setting is altered when setting the time, the seconds counter in the RTC will be reset. The DAY and MONTH settings do not cause the seconds counter to reset but the HOUR and MINUTE settings are written to. The YEAR and (P)rogram settings have no effect on the RTC.

Rain/temperature inputs

The three input circuits are identical and are based on LM393 comparator ICs. VR2-VR4 are used to adjust the trip voltages, which can vary from about 0.9V to about 2V. Resistors R3, R15 & R16 (1MΩ) provide hysteresis to prevent the outputs from oscillating.

R8, R9 and R10 provide the current feed to the rain switches and temperature sensor circuit. The output circuits of the rain switch and temperature sensor act as constant current sinks. If the probes are wet, then the Rain Switch draws an extra 13mA compared to when the probes are dry. The current flows to ground via 68Ω resistors R4, R14 & R17.

The extra current flowing when the probes are wet causes the voltage across these resistors to increase, which in turn causes the comparator to trip. Normally, the open collector outputs of the comparators are held high by 10kΩ pullup resistors. When they trip, the outputs turn on, thereby presenting a logic 0 to the microcontroller port pins (PD7, PD5 & PD4).

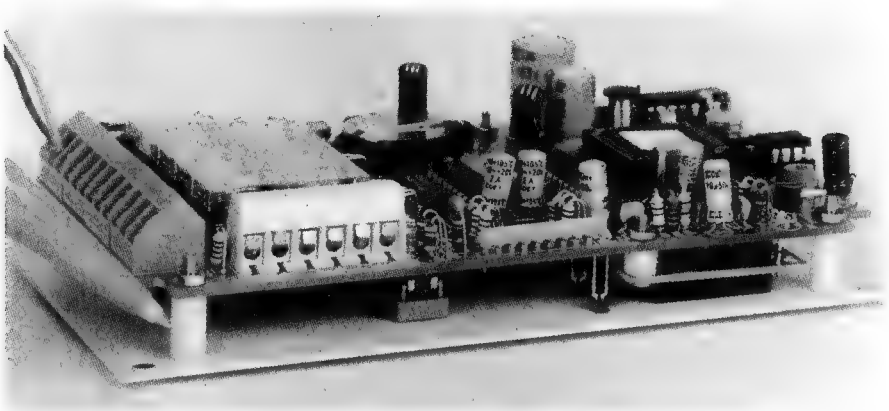
The temperature input requires a frequency that is directly proportional to the temperature at a resolution of 50Hz/°C. 1000Hz corresponds to 0°C, 2000Hz corresponds to 20°C and so on. When the temperature sensor is not connected, the temperature display will be -19.9°C.

Relay drivers & relays

IC7 drives IC5, a ULN2804 relay driver IC. This device has open collector outputs and can therefore be used to drive relays with an operating voltage different to that specified. To do this, the component side track marked "*" (above the battery holder) must be cut. A wire running off to a separate power supply is then soldered into the via on the solder side, about 10mm below the "*".

The controller can operate all of the specified relays at once if need be. Each relay draws about 41mA at 5V. This does not mean that all solenoids should be operated at once, however. This very much depends on the transformer that is used to power your sprinkler system. Most solenoids draw around 300mA when supplied by 24V AC.

Diodes D5-D12 form an 8-input diode AND gate. If any of the relays (RLY1-RLY8) is (are) switched on, then



The PC board is mounted on the front panel using 12mm spacers and machine screws and nuts. Similarly, the lower edge of the LCD module (near the LEDs) is secured to the PC board using 5mm spacers and machine screws and nuts.

the associated diode(s) will also be forward biased, thereby switching on RLY9 (the master relay). This relay can be used to switch on the master solenoid in a sprinkler system, or to start a pump in a rural situation.

Manual operation

In addition to automatic operation, the solenoids can also be switched on manually. To do this, you simply select the solenoid with the Menu button, then press the Down button; the selected solenoid will immediately turn on, as indicated by the fast flashing LED. It will subsequently automatically switch off after the "Run Time" of cycle 4 (cycle 8 if program C) for that solenoid has expired.

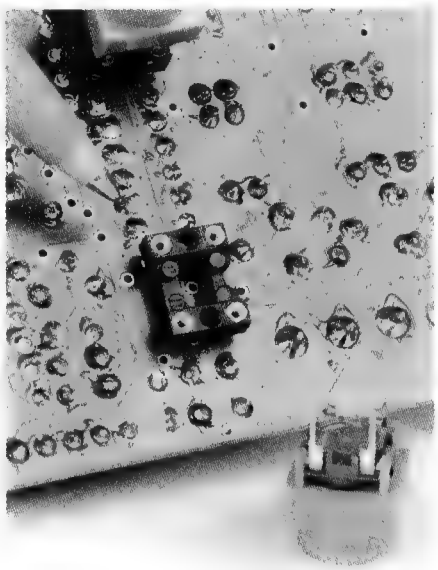
If the "Run Time" is set to "00", then the solenoid will switch off at the next interrupt from the RTC. Note that this facility works whether the "RAIN OFF" mode is active or not.

Construction

Construction of the Rain Brain is straightforward, since it is supplied as a complete kit. All the parts mount on a double-sided PC board with plated-through holes and a screened layout overlay, so that you can see at a glance where the parts go. As always, eyeball the PC board for any obvious faults before starting assembly.

Begin by fitting all the ICs and sockets (except the PLCC socket for IC4). The RTC IC (IC3) and the EEPROM(s) (IC1 & IC11) are the only ICs that require sockets. Do not use sockets for the other ICs. In particular, IC8 (LM2574-5) absolutely must be soldered to the PC board

This done, fit the PLCC socket. This



The five pushbutton switches are all mounted in modified 6-pin DIP sockets on the track side of the board. Note that two pins of each socket are removed – see text.

socket has one corner chamfered and this must match up with the screened overlay on the PC board. Also pin 1 on the PC board is square, and you will see a little ridge on the side of the socket that denotes pin 1. Do not plug the microcontroller in yet!

The three SIL resistor networks (R1, R2 and R7) should be installed next, noting that the pin with the dot goes into the square hole. Note that two of these resistor networks are 10kΩ types, while the other is a 1kΩ type so don't get them confused. All three can be either 9-pin or 10-pin types.

The following parts are mounted on the solder side of the board: LEDs 1-8 (discussed later), the five 6-pin DIP sockets, and the 14-pin SIL connector for the liquid crystal display.

Pins 2 & 5 of the 6-pin DIP sockets (used to mount the push buttons) have to be cut out so that they won't interfere with the PC board (pushing the pins out with the hot soldering iron results a neater job). Solder in all five sockets, then turn the board over and fit the battery holder (don't fit the battery yet). This done, solder in the 14-pin LCD connector, remembering that it goes onto the solder side of the board (along with the five switch sockets).

Next, fit the four trimpots (VR1-VR4) and the trimmer capacitor (C12). Set VR2, VR3 and VR4 to midway, then install power supply components IC8, C1, C2, D15 and L3. Note that the cathode of D15 goes into the square hole.

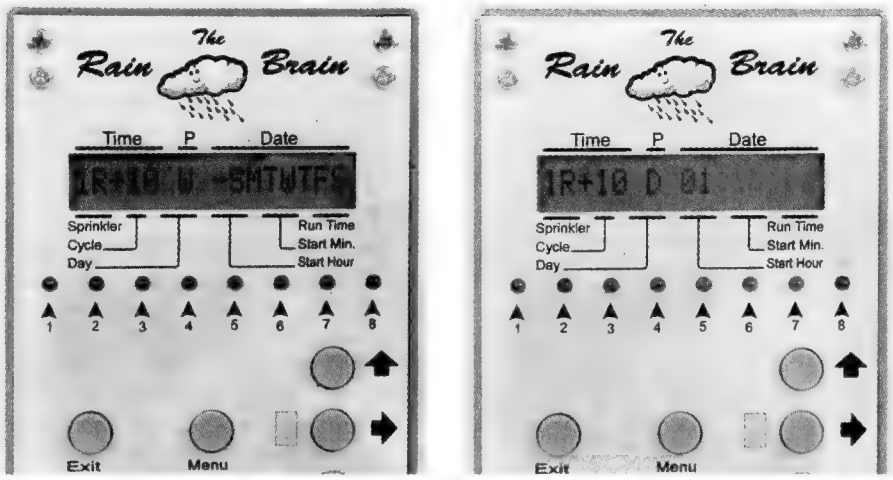
The resistors can now all be installed. In particular, install R15 (1MΩ near pin 1 of IC10) so that its long lead goes into the top hole. The same goes for R16 (1MΩ below IC10), while R3 (1MΩ near pin 1 of IC9) should have its long lead to the left. The reason for this is that these long leads are used as test points when adjusting the comparator trip points.

The capacitors, diodes, the transistor and the two crystals can be fitted now. You will notice that all the diode cathode pads have square holes, as do all the positive pads of the electrolytic capacitors.

L1 and L2 have small lengths (2-3mm) of spaghetti sleeving fitted over their mounting leads so that they stand proud of the board. If only one EEPROM is to be installed, solder a link between the bottom two holes of S6 (marked SW1 on the screened overlay). This links the A2 pin of IC1 to ground.

Installing the LEDs

As mentioned earlier, the LEDs are mounted on the solder side of the board, so that they match up with clearance holes in the front panel. Insert each LED into its position, remembering that the cathode (short lead) goes into the square hole but do not solder any yet. This done, carefully fix the front panel to the PC board using 12mm spacers and machine screws and nuts – just install two spacers diagonally opposite each other, as this is only a temporary operation. Once the panel is on, manipulate the LEDs so that they fit into



These two photos show typical displays for the Auxiliary Functions menu. At left, rain sensor 1 has been enabled (1R), the temperature trip point is 10°C, the three-week cycle mode (W) has been selected, week 1 has been selected (—), and the sprinkler will turn on every day of this week. In the photo at right, the continuous schedule (D) mode has been selected and the sprinkler will turn on every day (01).

the appropriate holes, then solder them in from the component side and remove the front panel.

Now fit the fuse clips and the connector blocks to the PC board. Don't fit the LCD or the relays yet, as a smoke test needs to be done first!

Smoke test

Before applying power, ensure that IC3, IC4, IC1, IC11 (if supplied) and the LCD have not been fitted. This done, connect a suitable power supply to the designated connectors and switch on.

Now check that 5V is present across the power supply pins of IC6 (or IC7); ie, between pins 20 & 10. If so, touch the top of each IC for a few seconds, particularly IC8. All the ICs should be cool to the touch. If all is well, switch off and plug in the rest of the ICs. Make sure that you install the microcontroller around the right way. The chamfered corner of the IC must match the chamfered corner of the socket.

Installing the LCD

Before installing the LCD, the six tabs that secure the metal frame to the LCD board should be bent over slightly. This is to prevent possible contact with any of the leads protruding through the main PC board. Also check that none of the tabs is shorting to any of the fine tracks around the edges of the tab holes.

Next, turn VR1 clockwise until it stops, so that it is in the full contrast position. This done, fit the LCD to the connector on the main board and force it down slightly so that it firmly grips the pins.

Now turn the power on, while making sure that nothing on the LCD board can short against the main board. You should be greeted with a message telling you to check the battery, a software version message for a second or two, and then the time and date display.

Assuming that all is well, the LCD can be permanently mounted. The lower edge of the LCD (near the LEDs) is secured to the main board using 5mm spacers and machine screws and nuts. Once these are fitted, judge the gap at the connector edge and solder tack a pin. This done, check that the LCD board is parallel to the controller board, adjust it as necessary, then solder the rest of the pins.

By the way, all the LCDs are tested before they are packed into the kits, as are the microcontrollers. However, it is still nice to know that it works before soldering it in as it is an unpleasant job trying to unsolder them.

The five pushbutton switches can now be installed by fitting them to the previously installed DIP sockets (there's no need to solder them). Once they're in, the plastic switch caps can be clipped into position.

If you have purchased the additional memory kit, solder the wires to the toggle switch, then mount the switch in a convenient location on the side of the case. Make sure that this switch can not foul other parts on the main board when it is installed in the case.

Now the front panel can be refitted using the four 12mm spacers provided. This done, clip the lithium battery into its holder (positive side up), connect a power supply and switch on. The LCD should go through the same routine as above. Once the time has been programmed into the RTC, the battery flat message should not show at power up unless the battery is flat.

Note that, at this stage, the time display will have miscellaneous characters in the time and date fields.

Memory initialisation

The next step is to put the memory into a known state. To do this, turn

Where To Buy The Parts

Parts for the Rain Brain Sprinkler Controller are available as follows:

ITEM	PRICE	P&P
Rain Brain kit (excludes relays)	$175.00	$10.00
Relays - FBR211D005M (Price ea.; specify number required)	$4.50	
Built & tested (relays extra)	$225.00	$10.00
Rain switch kit (Price ea.; specify number required)	$25.00	$2.00
Temperature probe kit	$33.00	$2.00
Optional memory kit	$12.00	$2.00
Optional super twist LCD with LED backlight upgrade	$8.00	

Note 1: p&p is $10.00 for Rain Brain kit plus any combination of other kits. Individual parts are also available (POA).
Note 2: Payment by cheque or money order to Mantis Micro Products. Send order to Graham Blowes, 38 Garnet St, Niddrie, 3402 Vic. Phone/fax (03) 9337 1917. For COD orders, you pay $4.75 COD charge plus postage at the destination post office. The Post Office will notify you when the parcel arrives.

PARTS LIST

1 double-sided PC board, code SPV6
1 plastic case with screened front panel
1 P1601 liquid crystal display (H1)
1 BH800 battery holder (BH1)
1 3V lithium battery (B1)
9 5V SPDT relays, FBR211CD005M (RLY1-9)
2 M205 fuse clips (FH1,FH2)
1 1A M205 fuse (F1)
2 ferrite (6-hole) inductors (L1,L2)
1 470µH inductor (L3)
1 50kΩ miniature horizontal trimpot (VR1)
3 10kΩ miniature horizontal trimpots (VR2-VR4)
1 44-pin PLCC IC socket
1 8-pin DIP socket
1 16-pin IC socket
5 momentary contact pushbutton switches plus plastic caps (S1-S5)
5 6-pin DIP sockets (for switches)
4 15mm x 3mm dia. machine screws plus nuts
4 12mm x 3mm dia. spacers
2 5mm x 3mm dia. spacers
1 14-way connector (X1, for LCD)
1 6-way terminal block (X2)
4 3-way terminal blocks (X3-X6)
2 PC pins (X7,X8)

Semiconductors
1 CAT24C08P EEPROM (IC1)
1 LM7555 CMOS timer (IC2)
1 PCF8573P real time clock (IC3)
1 MC68HC705C8FN microcontroller (IC4)
1 ULN2804 8-channel driver (IC5)
2 74HC573 latches (IC6,IC7)
1 LM2574-5 5V switching regulator (IC8)
2 LM393 dual op amps (IC9,IC10)
1 BC548 transistor (Q1)
4 1N4004 silicon diodes (D1-D4)
11 1N4148 silicon diodes (D5-D14,D16)
1 MUR120RL fast recovery diode (D15)
8 3mm red LEDs (LED1-8)
1 32.768kHz crystal (Xtal1)
1 3.579545MHz crystal (Xtal2)

Capacitors
1 1000µF 16VW electrolytic (C2)
1 220µF 63VW electrolytic (C1)
4 10µF 10VW electrolytic (C3,C4,C10,C11)
1 1µF 10VW electrolytic (C13)
10 0.1µF monolithic (C5-8,C14-18,C20)
2 27pF monolithic (C9,C19)
1 3-40pF trimmer capacitor (C12)

Resistors (0.25W, 1%)
1 10MΩ
4 1MΩ
1 33kΩ
5 10kΩ
1 4.7kΩ
5 2.2kΩ
1 1kΩ
3 470Ω 1W
3 68Ω
2 10kΩ SIL resistor networks
1 1kΩ SIL resistor network

Optional memory kit
1 CAT24C08P EEPROM (IC11)
1 8-pin DIP IC socket
1 SPDT switch (S6)

off the power, hold down the Menu and Cursor (⇒) buttons, and turn the power back on. This time, the LCD will tell you to press the Menu button. Once this is done, the "Config" menu will be displayed. This consists of three options:

(1). "M" is memory initialisation. Press the Down (⇓) button to initialise the memory. As each block of 16 bytes is initialised, a LED lights. The LEDs chase each other from left to right, eight times. This routine also acts as a fault locater. If more than one LED lights at the same time, then there is a short circuit on the port B data bus.

Each cycle is set to 00:00:00 which is actually a start time of midnight, with a run time of 00 minutes. All cycles and both rain switches are enabled. The temperature trip point is off. The 3-week cycle is active, with all days set to on (uppercase).

(2). Press the Cursor (⇒) button to move to the next option (A) which is the VR4 adjusting mode. This mode continually reads the temperature and displays the result. If VR4 is adjusted correctly, the display will show a steady temperature. How to do this is included as part of the temperature sensor kit.

(3). D is the default display setting. A "D" indicates that the date will be displayed in the default display. A "T" means that the temperature will be displayed instead of the date. Press the Down (⇓) button to toggle from "D" to "T".

Adjustments

The contrast pot (VR1) should already be set up. The range isn't very broad, so maximum is probably the best to start with (fully clockwise). The other pots (VR2-VR4) were originally set during construction.

Assuming that you are using the optional Mantis Rain Switches (available from the author), VR2 and VR3 can be further adjusted to set the trip voltages to 1.5V. This can be monitored by connecting the positive lead of your meter to the top lead of R15 for Rain Switch 1 (VR2), or to the top lead of R16 for Rain Switch 2 (VR3).

To adjust IC3's oscillator, connect a frequency meter to the pin marked "128Hz" (X7) and the ground lead to the GND pin (X8) nearby. Now tune C12 until a display of "128.0000 Hz" is obtained. Note that the frequency counters built into some multimeters will probably prove unsuitable, as they do not have the resolution required.

If a frequency meter is unavailable, check the time against a known good source and tweak the trimmer until the unit keeps good time.

Installation

The case is not waterproof, so mount it on a wall in the garage or in some other sheltered location. If you must have it outside, the controller will have to be installed in a waterproof case.

You will have to drill two rows of five holes (5mm dia.) in the bottom of the case to provide access for the external wiring. Position one row close to the back of the case and the other row about 5mm away.

Programming

At first sight, programming this controller may seem a little daunting but it only takes about 20 minutes to get the hang of things. If you can program a VCR, you can program this device.

We don't have space to include the programming instructions here but full instructions will be supplied with the kit. SC

PRODUCT SHOWCASE

Tektronix P5200 high-voltage differential probe

The measurement of high voltage or AC mains voltage signals presents problems that are not easily overcome with standard dual channel oscilloscopes. One solution is to use a Tektronix P5200 high voltage differential probe.

The attenuators of most general purpose oscilloscopes provide a maximum input sensitivity of 5V/division. With the screen displaying eight vertical divisions this means that the maximum input signal can only be 40V peak-to-peak with a direct probe or 400V peak-to-peak using a 10:1 divider probe. Larger signals can be displayed using the variable input control but then the amplitude measurement facility is lost.

If the signal to be measured is a mains AC waveform or other higher voltage which is not ground referenced then it can be displayed using a dual trace oscilloscope in the Add mode. Once again the maximum calibrated display voltage will be 400V peak to peak. As an alternative, some organisations adopt the practice of using an oscilloscope with its mains earth disconnected to display floating and mains voltages. This is a highly dangerous procedure with nothing to recommend it.

Displaying the mains voltage waveform using a regular probe with the tip connected to the active lead and the earth clip connected to the neutral is also a dangerous procedure. Transposition of the live and neutral connections to the probe is always a possibility and if this mistake is made then the best that can happen is a blown fuse and the worst is electrocution.

What is really required is an instrument with a differential input, some level of signal attenuation and a single ended output signal to apply to the following measuring equipment. To cater for signals with fast rising wave fronts – eg; SCR circuits, switchmode supplies, etc – it should also have a wide bandwidth and fast rise time.

The Tektronix P5200 high voltage differential probe meets all these requirements and allows the aforementioned measurements to be made easily and safely. It is supplied with two sets of connectors and a 9VDC 1A plug-

Table 1: Specifications

Maximum applied voltage between either input and ground	1kV (DC + peak AC)
Maximum applied voltage between inputs	1.3kV (DC + peak AC)
Rise time	<14ns in 1/50 range
DC CMRR	>5000:1 at 500VDC
AC CMRR	60Hz >10000:1; 100kHz >300:1; 1MHz >300:1
Bandwidth	DC to 25MHz (-3dB) in 1/50 range
Maximum operating input voltage	1/500 differential 1.3kV (DC + AC peak); 1/500 common mode, 1kV (DC + AC peak); 1/50 differential, 130V (DC + AC peak); 1/50 common mode, 1kV (DC + AC peak)
Range accuracy	±3% between 20-30°C after 20 minute warmup.
Input impedance	8MΩ + 3.5pF between inputs; 4MΩ +7pF each input to ground
DC output drift	±0.5mV/°C
Propagation delay	20ns
Operating temperature range	0-40°C

pack power supply. One pair of connectors are long reach plunger probes and the other pair are heavy duty, double insulated crocodile clips.

Its dimensions are 185mm (L) x 66mm (W) x 32mm (H). Two 500mm long input connectors are at one end of the case and these are terminated with shrouded plugs to fit the probe connectors. At the other end of the case is a 1500mm long output lead terminated with a moulded plug that carries an input socket for the plugpack and a 300mm long coaxial lead terminated with a BNC male plug to supply output to the measuring instrument which will usually be an oscilloscope.

The face of the probe case features a pushbutton switch which provides 1/500 or 1/50 attenuation to the input signal. There are also LEDs for Power and Over Range and a table showing the effective volts/division of the combined probe plus oscilloscope for different settings of the oscilloscope's input attenuator. Output level from the probe is a maximum of 2.6V.

The specifications for the P5200 are shown in Table 1.

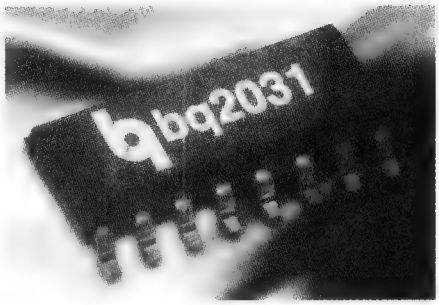
We used a sample P5200 in our laboratory and found that it does all that is claimed for it. It enables safe and accurate measurements when the source is not referenced to ground, particularly where mains voltage signals are concerned. In addition, it offers a much higher common mode rejection ratio than any typical dual channel oscilloscope when used in the "Add" mode – an important advantage.

The Tektronix P5200 is priced at $658 plus sales tax where applicable. For further information, contact Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde, NSW 2113. Phone (02) 888 7066 or fax (02) 888 0125.

Fast-charger IC for lead-acid batteries

Reptechnic has introduced the Benchmarq bq2031 lead acid fast charge IC. This incorporates current and voltage regulation with fast charge control to produce a highly cost effective fast charge system.

Available in a 16-pin narrow DIP or SOIC package, the bq2031 is designed for controlling constant voltage and constant current charging of lead acid



batteries in emergency lighting, backup power, industrial equipment and consumer electronics applications. It can be configured for linear or gated current regulation applications.

The bq2031 meets the battery manufacturers' charge recommendations for both cyclic and float/maintenance charge. It includes a flexible pulse width modulation regulator which is suitable for high efficiency switchmode designs. Direct LED control outputs are featured for displaying charge status and fault conditions.

Pre-charge qualification tests have been performed on the device for shorted, open or damaged cells, allowing it to condition the battery for fast charge. Charging is also qualified by selectable temperature and voltage

KITS-R-US

PO Box 314 Blackwood SA 5051 Ph 018 806794

TRANSMITTER KITS

- FMTX1 $49: a simple to build 2.5 watt free running CD level input, FM band runs from 12-24VDC.
- FMTX2B $49: the best transmitter on the market, FM-Band XTAL locked on 100MHz. CD level input 3 stage design, very stable up to 30mW RF output.
- FMTX2A $49: a universal digital stereo encoder for use on either of our transmitters. XTAL locked.
- FMTX5 $99: both FMTX2A & FMTX2B on one PCB.
- FMTX10 $599: a complete FMTX5 built and tested, enclosed in a quality case with plugpack, DIN input connector for audio and a 1/2mtr internal antenna, also available in 1U rack mount with balanced cannon input sockets, dual VU meter and BNC RF $1299. Ideal for cable FM or broadcast transmission over distances of up to 300 mtrs, i.e. drive-in theatres, sports arenas, football grounds up to 50mW RF out.
- FMTX10B $2599: same as rack mount version but also includes dual SCA coder with 67 & 92kHz subcarriers.

AUDIO

- DIGI-125 Audio Power Amp: this has been the most popular kit of all time with some 24,000 PCBs being sold since 1987. Easy to build, small in size, high power, clever design, uses KISS principle. Manufacturing rights available with full technical support and PCB CAD artwork available to companies for a small royalty. 200 Watt Kit $29, PCB only $4.95.
- AEM 35 Watt Single Chip Audio Power Amp $19.95: this is an ideal amp for the beginner to construct; uses an LM1875 chip and a few parts on a 1 inch square PCB.
- Low Distortion Balanced Line Audio Oscillator Kit $69: designed to pump out line up tone around studio complexes at 400Hz or any other audio frequency you wish to us. Maximum output +21dBm.
- MONO Audio DA Amp Kit, 15 splits: $69.
- Universal BALUN Balanced Line Converter Kit $69: converts what you have to what you want, unbalanced to balanced or vice versa. Adjustable gain. Stereo.

COMPUTERS

- Max I/O Card for PCs Kit $169: originally published in Silicon Chip, this is a real low cost way to interface to the outside world from your PC, 7 relays, 8 TTL inputs, ADC & DAC, stepper motor drive/open collector 1 amp outputs. Sample software in basic supplied on disk.
- IBM PC 8255 24 Line I/O Card Kit $69, PCB $39: described in ETI, this board is easy to construct with only 3 chips and a double sided plated through hole PCB. Any of the 24 lines can be used as an input or output. Good value.
- Professional 19" Rack Mount PC Case: $999.
- All-In-One 486SLC-33 CPU Board $799: includes dual serial, games, printer floppy & IDE hard disk drive interface, up to 4Mb RAM 1/2 size card.
- PC104 486SLC CPU Board with 2Mb RAM included: 2 serial, printer, floppy & IDE hard disk $999; VGA PC104 card $399.

KIT WARRANTY – CHECK THIS OUT!!!

If your kit does not work, provided good workmanship has been applied in assembly and all original parts have been correctly assembled, we will repair your kit FREE if returned within 14 days of purchase. Your only cost is postage both ways. Now, that's a WARRANTY!

KITS-R-US sell the entire range of designs by Graham Dicker. The designer has not extended his agreement with the previous distributor, PC Computers, in Adelaide. All products can be purchased with Visa/Bankcard by phone and shipped overnight via Australia EXPRESS POST for $6.80 per order. You can speak to the designer Mon-Fri direct from 6-7pm or place orders 24 hours a day on: PH 018 80 6794; FAX 08 270 3175.

NOT COMING TO A NEWSAGENT NEAR YOU!

The new **1996 AV-COMM SATELLITE TV CATALOGUE**, contains up to the minute information on all available satellites and equipment needed to receive them.

Contains detailed information on over 200 products covering all aspects of Satellite Television Reception.

For your **FREE** copy of the new 1996 AV-COMM CATALOGUE simply complete the coupon and send to: AV-COMM PTY. LTD. P.O. Box 225, Balgowlah NSW 2093.

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YES Garry, please send me a FREE copy of the 1996 AV-COMM Satellite TV Catalogue.

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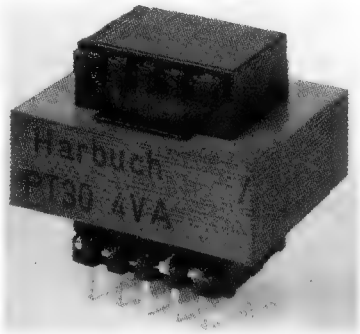
PCB POWER TRANSFORMERS
1VA to 25VA



Manufactured in Australia
Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 476-5854 Fx (02) 476-3231

limits. Key specifications include temperature, float voltage reference, pin selectable charge and maintenance modes, and pin selectable charge termination by maximum threshold voltage, minimum current and maximum time.

A switchmode development system, the DV2031S1, is available to allow designers to experiment with the bq2031. For further information, contact Reptechnic, 3/36 Bydown St, Neutral Bay, NSW 2089. Phone (02) 9953 9844.

Jaycar kits now made under AS9002

The head office, warehouse and kit department of Jaycar Electronics has successfully passed all requirements and has been accredited to AS/NZ ISO 9002:1994.

"We realised that sooner or later we would have to seek this level of quality of management, documentation and quality control," commented Managing Director, Gary Johnston. "As it turned out, our existing organisation was close to the high standards required anyway, so achieving the AS9002 level of quality was not particularly difficult. Our kits have always been very high quality. Now we have independent proof that they are."

According to Mr Johnston, the quality accreditation is part of an ongoing commitment by Jaycar to provide a high standard of service in the industry.

Pocket-sized fax machine & organiser

Now available at Dick Smith Electronics, the Handifax 1000 is a 256K electronic personal organiser and fax machine in one. In a lightweight, compact 72 x 198mm unit, Handifax 1000 gives you the capability of faxing your colleagues and clients anywhere, any time, by simply using it in conjunction with a standard touch tone telephone or analog mobile phone.

Simply type the message you want to fax, place the handset of the telephone or mobile phone on the acoustic coupler speaker and microphone, dial the fax machine you are calling and press SEND.

Handifax 1000 can communicate with any standard fax machine at speeds of up to 9600 bps. Quick and simple to use, it will hold up to 120 faxable pages and its auto dialling facility ensures that there is no need to manually dial numbers or access codes. The unit has built-in fax cover pages and the ability to customise fax headers, standard orders, invoices, etc.

With a 256K memory, Handifax 1000 also doubles as a personal organiser, capable of storing more than 3500 entries. A 7-digit password can be used to protect all data. An optional PC interface allows users to back up and store information on any standard IBM compatible PC.

The Handifax comes complete with an operation manual, an instruction video and is available at all Dick Smith Electronics stores for just $699. **SC**

YOU CAN NOW AFFORD YOUR OWN SATELLITE TV SYSTEM

For many years you have probably looked at satellite TV systems and thought "one day"

Your own K-band system from only:

$995

HERE'S WHAT YOU GET:

- Prime focus dish configured to your location.
- Super low noise LNB/feedhorn.
- 25m low loss coaxial cable.
- DYNALINK 50 channel stereo satellite receiver, with remote control. Pre-programmed to Optus frequencies.
- Pointing co-coordinates for your location.

BEWARE OF IMITATORS

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PO BOX 225, Balgowlah NSW 2093
Tel: (02) 9949 7417 Fax: (02) 9949 7095

Ask about our regular newsletters and Customer BBS. Send coupon for your free info pack, listing all items and prices.

YES GARRY, please send me more information on K-band satellite systems.

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ACN 002 174 478

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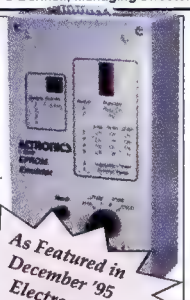
For Ultra Quick delivery.

Phone Order on 1-800 999 007.

Jetservice Delivery - next day all capital cities and suburbs, please add 24 - 48 hours for country clients.

Regards, Jack O'Donnell, Managing Director

EPROM Emulator Kit



(See EA Dec '95) This EPROM emulator allows you to do away with EPROM's whilst in the prototyping stage of product development. The emulator is connected to a spare parallel port on your computer and also the 'target' board. The EPROM file (that is normally downloaded into the EPROM), is then transferred into the emulator by copying the file to the parallel port. This process saves repetitively "blowing" new EPROM's with each modification to the program. Emulates 2764, 27128, 27256 and 27512 EPROM's.

K 9530 ***Just* $149**

As Featured in December '95 Electronics Australia

Signal Comparator Kit

(See EA Aug '93) If you have ever tried to fix a circuit without a circuit diagram you will know how frustrating it can be. If you have an operational unit this can ease the pain but still, difficulties can be incurred. This kit could help. It can compare two circuits point to point and will indicate any difference between them.

K 2563 Normally $39.95,

This Month Only $29

Guitar Headphone Amplifier Kit

(See SC May '95) Now you can practice your guitar at any time by using this low cost amplifier. It provides ample power for headphones so that you can play to your heart's content without disturbing the rest of the household or your neighbours. Simply plug in your guitar, headphones and a 12V AC power supply (not included).

K 5537 Normally $29.95 **Now $25**

M 9120 12V AC Plugpack to Suit $12.95

Digital Storage C.R.O. Adaptor Kit for P.C.'s

(See EA Jan '93) This great kit enables a P.C. user to capture a waveform and zoom in to segments of interest then save them to disc. The unit has 32K of storage memory and a sampling rate of over 600K samples per second. Input level of up to 2.5 Volt. Full sampling rate between 15K s/s to over 600K s/s. Input impedance of 1M ohm.

K 2805 Normally $63.50,

This Month Only $55

K 2812 PC 3.5" Disk Software to Suit $29.95

Sub-Woofer Controller Kit

Add Incredible Bass to Your Hi-Fi or Home Theatre System!

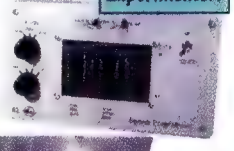
(See SC Dec '95) A very exciting subwoofer adaptor design published in Silicon Chip Magazine. ***High level inputs*** enables simple parallel connection to either left or right stereo speaker. ***Low level inputs*** allows connection to surround sound subwoofer output or standard stereo signal. eg CD, VCR etc. ***Other features*** of this excellent design includes: • Variable filter output frequency • Inbuilt compressor/limiter prevents overdrive clipping • Subsonic filter (below 15Hz) • Auto input signal sensing and 24V power up facility for external sub power amplifier • "In Phase" and "Out of Phase" outputs enable bridge mode output if desired. Very compact, only 200W x 160D x 70H mm. Two versions available, PCB and components kit only (K 5562), or complete with a case, power supply and PCB (K 5563).

K 5562 Short Form Version (PCB & Parts Only) **$49**

M 9120 12V AC Plugpack to Suit K 5562 $12.95

K 5563 Full Version (Includes PCB, Components, Case & Power Supply) **$99**

PC Based EPROM Programmer Kit



A must for the Experimenter!

(See EA Sept '93) This is a great new kit for programming EPROM's from 2716 to 27256. Compares favourably against commercial units costing $$$ more. This kit puts you in the driving seat for under $100. It is flexible enough to be able to program 12.5, 21 and 25V EPROMs/EEPROMs.

K 9525 **$97.50**

K 9526 3.5" PC Software to Suit $19.95

50W Mosfet Amp Module Kit

Ultra Compact Design!

This great module features moderate power output at low harmonic distortion. Simple to build and compact in size this unit makes a great replacement module for your old Hi-Fi or buy two and make your own stereo amplifier. Requires ±50V DC supply.

Power Output: .....50W into 8Ω
Freq. Response:.....25Hz-20kHz,±1dB
Input Sensitivity:....1V RMS
T.H.D.:.....0.05%

K 5115 **$54.95**

5 Band Graphic Equaliser Kit

NEW

(See SC Dec '95) Liven up your keyboard, guitar or music system with this 5 band graphic equaliser. It uses only a few low cost parts and parts and will vastly improve the versatility of your sound system. Bands are centred at 63Hz, 250Hz 1kHz, 4kHz and 16kHz, with a ±12dB boost/cut adjustable level on each band. Requires ±15V power supply (not included).

K 5305 **$39.95**

Impedance Meter Kit

Measuring a transformer with a standard ohm meter will not give accurate results because it is measuring with a DC signal, not AC. This invaluable unit is fantastic for checking transformers and speaker impedances. For those people dealing in PA equipment, the built in tone generator enables an entire PA system to be checked before the amplifiers are connected. Uses one 9 Volt battery. (Not supplied). Three ranges enable accurate measurement of 2 - 20,000 ohms. Accuracy mid range typically ±5%.

Great for measuring:
• Speaker impedances
• Line transformer / audio transformer impedance and reflected impedance etc • Speaker circuit total impedance & more.

K 2550 Kit Version **$99**

K 2551 Fully Built & Tested Version **$159**

Ignition Killer Kit

NEW

(See SC Dec '95) There are many ways of theft prevention for your vehicle. Disabling the ignition is perhaps one of the better methods, as it can totally immobilise the car. This ignition killer will help prevent your car from being stolen by producing erratic behaviour in the ignition system. The thief will suspect a problem with the car and leave it.

K 4380 **$29.95**

Digital Announcement Recorder Kit

1000's Uses Include Car Warning Alert, Alarm Systems, Door Bell etc.

(See EA Feb '95) This kit is an extremely flexible microprocessor controlled eight channel digital voice recorder. Requires no battery back up for memory. Will record up to 8 different messages, with a total time up to 16 seconds. Each message can be individually triggered. Features chime function, an on-board 2 watt amplifier, negative or positive trigger, once only or recycling announcement function etc.

K 9580 **$109**

High Efficiency Fluro Inverter Kit

Ideal for Camping, Farmers, Fixing cars etc.

(See SC Nov '93) Ideal for camping, fixing cars etc. This circuit will drive a standard 40 Watt fluro tube from a 12 volt source. Being a fluro light, it draws less current than an incandescent globe. Features flicker free starting/running, reverse polarity protection and faulty tube protection. Globe and housing not included. Requires 11 to 14V DC power source. Suitable for 18, 20 36 and 40W globes. Low EMF radiation.

K 6370 **$69.00**

Auxiliary Battery Manager

NEW

(See EA Jan '96) Ideal for four wheel drives, trucks or any lead acid battery application. This is a 'smart' manager for an auxiliary lead acid 12V battery. Charges the auxiliary cell after the main cell has been recharged. Unit features controlled current charging for flat auxiliaries and full current charging when its terminal voltage rises above 11V. Also, this unit isolates the auxiliary battery from the electrical system when the ignition is off.

K 4330 **$49.95**

1-800 999 007 PERTH (09) 328 1599

OVERNIGHT DELIVERY

The Powerhouse 600W & 1200W Inverters

(See EA Feb '92) These Power Inverters will provide all your power requirements from a heavy duty 12 or 24V battery. Using the latest Mosfet output stage and toroidal transformer the inverters are both efficient and will deliver high surge currents. The Powerhouse has been designed not only for rugged operation but for ease of construction. The kits comes to you in a fully drilled, pre punched chassis complete with silk screened front panel. Assembly of the kit is simplified as the majority of components mount on a single PCB. Thus virtually eliminating all external terminations. Suitable for use in camping, boating, fishing, mining, farming, remote settlements etc.

Now with Improved Circuitry!

K 6776 12V Input, 600W Kit Version
K 6778 24V Input, 600W Kit Version **$535**

K 6796 1200W Kit Version
K 6798 1200W Kit Version **$799**

Get 240V from Your 12V or 24V Car/Boat/Truck Battery!
Ideal for Camping, Boating, Farming etc.

At Last - An Accurate Digital LCR Meter

In the past multimeters including inductance and capacitance ranges have been relatively mediocre in their performance. This new model will measure inductance, capacitance and AC resistance with great accuracy! Ideally suited for speaker crossover design and transformer/coil manufacture. Supplied complete with two sets of leads and inbuilt sockets for direct measurement of inductors, capacitors or resistors. Includes integral bench stand.

Resistance Ranges: 20, 200, 2k, 20k, 200k, 2M, 20M
Capacitance Ranges: 200pF, 2nF, 20nF, 200nF, 2µF, 20µF, 200µF
Inductance Ranges: 2mH, 20mH, 200mH, 2H, 20H, 200H
Accuracy: .....Better than 5%

Q 1010 Normally $199, **Now Only $149**

PCB Spacers

We are massively over-stocked with incorrectly supplied PCB spacers - incorrect because they have an odd UNC4/40 thread. Although perfectly fine with the correct bolt, we are unable to sell them separately. So out they go at never to be repeated prices. All are quality heavy duty nickel plated brass.

All are supplied in packs of 100 spacers with 200 6mm bolts.

HX1391 10mm Spacer **$7.50**
HX1394 15mm Spacer **$10**
HX1397 25mm Spacer **$15**

Massive Savings on Regular Prices. Save Up to 60%

True RMS Digital Multimeter with RS-232

Supplied with high quality hard carry case and silicon test leads. This 3.75 digit 4000 count digital multimeter would have to be one of the best meters we have seen. Features include menu driven functions (no complicated instructions to remember), large backlit display, timer function, 20 amp current scale and many more.

Other Features: • RS-232 Mode • True RMS mode • Large display includes main and sub displays with bargraph • 10 Location memory • Stop watch/pre-settable count down timer • Minimum, maximum, average and relative modes • Decibel measurement • Capacitance and inductance measurement • Temperature mode (°C and °F) • Pulse signal generator for logic and audible testing etc • Continuity and diode test • Logic test • Auto power "off" and "keep on" mode • 20A current range • Warning buzzer sounds when leads are incorrectly inserted in the 20A current mode • Back lit display • Data hold and run mode • Low battery indication • Overload protection • Safety design in compliance with UL 1244 and VDE0411

Specifications & Ranges Available:

DC Volt: 400mV, 4V, 40V, 400V, 1000V
AC Volt: 4V, 40V, 400V, 750V
DC Current: 400µA, 400mA, 20A
AC Current: 400µA, 400mA, 20A
Frequency: 10kHz, 100kHz, 1MHz, 10MHz
Resistance: 400Ω, 4kΩ, 40kΩ, 400kΩ, 4MΩ, 40MΩ
Capacitance: 100µF
Inductance: 100H
Temperature: .....-17° - 1093° C (0° - 2000° F)
Display: .....3.75 digit, 4000 count LCD

Q 1098 $299

Q 1092 K Type Temperature Probe to Suit **$22.00**
Q 1093 Protective Carry Holster to Suit **$13.50**

Highly Recommended for Scientific Research & Development Work

Includes Software for DOS & Windows. Will Graph, Sample, Display all Multimeter Functions!

Famous Labtech 20MHz Dual Trace Oscilloscope

This model is a dual trace, 20MHz oscilloscope with a high brightness CRT. The vertical amplifiers have high sensitivity of 5mV/div and a frequency characteristic response with a smooth roll off exceeding 20MHz. The TV sync. signal operator circuit is provided to ensure stable observation of video signals. Triggering is obtained by sampling the AC power waveform, external waveform or internally generated trigger.

Now With Component Test Function! Now Over 2000 in service throughout Australia including many 100's in Universities, Research Establishments and Industry

Q 0156 Normally $729.00

***This Month Only* $649**

Q 0175 Cro Probes to Suit **$39.95 Each**

Polypropylene Speakers

Fax Us on (09) 328 3487 Altronics for Full Specifications

Save 25%

These fantastic speakers are ideal replacement speakers or for your own speaker design. The lightweight plastic cones offer levels of performance above that of conventional cardboard cones. The cone is more rigid and does not "break-up" (flex) as much as its counterparts.

		Watts RMS	Watts Max	Normally	This Month
C 3055	6.5" Woofer/Midrange	30W	50W	$29.95	**$22.50**
C 3060	8" Woofer	60W	100W	$59.95	**$44.95**
C 3065	10" Woofer	60W	100W	$79.95	**$59.95**
C 3070	12" Woofer	100W	150W	$99.00	**$73.95**
C 3075	15" Woofer	120W	200W	$139.95	**$104.95**

High Performance 2 Way Flush Mount Ceiling Speaker System

Ideal for Home Theatre Surround Sound or Hi-Fi Extension Speakers!

Designed to be installed into ceilings or walls, this slim profile attractive speaker system/grill assembly will compliment any sound system. Installation is simplified by use of mounting frame (which could be installed during construction) which the speaker assembly attaches to. Full mounting kit supplied, including fixing screws. Employs a 165mm (6.5") latex covered driver and a high efficiency polymylar tweeter coupled with a high quality crossover. The grill and exposed surround can be painted to match existing decor.

Save Over $50 a Pair

Specifications: • **Impedance:** 8 Ohm • **Power Input:** 30W RMS • **Frequency Response:** 50Hz - 20kHz • **Colour:** Ivory White • **Dimensions:** ≈306L x 220W x 86H mm

C 0884 Normally $250 **Per Pair,**

This Month Only $199 Per Pair

Highly Recommended. I found it difficult to pick the difference between the Altronics C 0884, the American Sonance and Boston Acoustic Systems both costing around $600.00 a pair
John Negus - Leading WA Audiophile

24 Hour Timer

These Timers Are Made by the Same Manufacturer as Those Sold by Major Hardware Stores & Supermarkets!

Programming is done by simply inserting the supplied pins into the appropriate time slots. On and off times are in multiples of 30 minutes. Includes manual on/off switch.

A 0301 Normally **$26.50**, **This Month Only $16.50**

These Timers Can be Used for Security, Pool Pumps & Heaters, Electric Blankets, Lights, Radios, Reticulation etc.

7 Day Electronic Timer

This Month Save 30%

Excellent for home security. 6 different programs can be set to activate any specified day of the week. All 6 programs operate independent of each other. With normal operation the in-built LCD digital display clearly shows the current time and day of the week. Internal rechargeable backup battery will maintain all program settings and current time for up to approximately 100 hours in the event of a power failure. Simple to program. Includes manual on/off/automatic control. 16 amp at 240V AC maximum current rating.

A 0303 Normally **$49.50**, **This Month Only $34.50**

ALTRONICS Fax Order Line: (09) 328 3487

1-800 999 007 PERTH (09) 328 1599

ALTRONICS COMPONENTS

ALTRONICS Fax Order Line: (09) 328 3487

Multi-Function Remote Car Alarm

S 5205 **$199**

Easily the Best Car Alarm We Have Ever Evaluated!

This amazing model features just about everything you could imagine. Multi-function key ring remote control will arm and disarm alarm (and activate central locking if fitted), panic and even open the boot (if actuator fitted). Other features include starter inhibitor, valet mode, central locking interface, flashes car indicators when tripped, auto reset, user programmable options plus much more. Also includes two spare electric outputs which are operated by the key ring remote control, these can be used to chirp the horn, turn on the car headlights or a myriad of other functions! Can be configured to automatically re-arm if a door is not opened within 22 seconds after disarming (avoids accidental disarming). Full battery backup siren includes built-in batteries, charging circuit, siren and key on/off switch.

Features: • Supplied complete with two miniature remote controls • Remote arming and disarming • Super Loud 127dB siren • Remote panic function • Full battery backup and tamper proof siren • Child proofing and anti intrusion alert while driving • User selectable exit delay and automatic re-arming • User selectable arming/disarming chirp • User selectable auto arming • Starter disable • Valet mode can be activated by remote or glove box switch • Automatic shunt of any defective entry zone • Turns on interior lights for 20 seconds when alarm is disarmed • Alarm memory indicates which zone (1-3) triggered • 60 second siren with auto reset • Two colour LED status indicator • Can be interfaced with central locking (where fitted) • 3 extra channels on remote to control other vehicle features such as boot release, etc.

14,400bps Internal Fax/Modem with Internet Access Software

Connect to the information super-highway on the Internet and explore the world!

Using the latest in digital signal processing, this internal fax/modem will give you years of service. Supplied with WinFax Lite for Windows, and DosFax Lite for DOS, this software will let you send/receive faxes direct from your PC. Features 5 year warranty. Austel approved.

Turn Your PC into a Fax!

NEW

Amazing Value! 14.4bps Fax/Modem for Under $200. Includes Software to Access the Internet.*

* Service charges apply.

D 1650 **$199**

Professional 8 Zone Digital Alarm System with Auto Dialler

NEW

This alarm panel is the same type as used by many commercial alarm companies to protect both residential and commercial properties.

Incorporating an inbuilt Austel approved auto-dialler, this great alarm can be configured to automatically dial two preset numbers in the event of an alarm, i.e. could be configured to automatically ring a neighbour or an alarm monitoring company. The main controller circuitry is housed in a sturdy steel cabinet. Provision is made to house an optional back up battery. The keypad control unit is generally located at the front door for easy access to arming and disarming of the system. The entire system is controlled and programmed via this keypad. Virtually any type of sensor can be used with this system. A combination of normally open and normally closed sensors can be used on any zone. Each zone is monitored by end of line resistors to maintain system integrity, i.e. if someone interferes with the system wiring the alarm will sound immediately.

Features: • microprocessor controlled • 8 fully programmable supervised zones • supervised fire zone • 1 auxiliary normally open zone • 3 keypad activated zones • two master codes, one installer code and 16 user codes • monitor function which tests features like battery backup and mains failure • eight individually and fully programmable zones with a large array of functions available • all eight sectors utilise extensive noise protection circuitry and end of line resistors for added security • once triggered, the alarm has the option of a silent alarm, and dialling a friend or monitoring company • quick arming option • zone bypassing for sectors which are false triggering • bell test - to test the external sirens without dialling out • door chime mode for entry/exit paths • battery backup • home or away operation • accessible alarm memory for confirming which sectors were triggered • separate instruction and installation manuals • 12 months warranty • system information can be down-loaded to a printer

S 5495 **$389**

M 9140 16V AC Plug Pack with Earth to Suit $32
S 5069 12V 4AH Backup Battery to Suit $49.95

PIR Movement Detector

5 Year Warranty

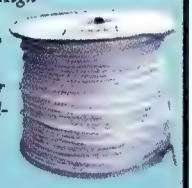
Small and sleek this detector is ideal for the home or the office. Range up to 13 x 13m.
Features: • LED On/Off Jumper • Vertical Adjustment • Wall/Corner Mounting • Small Size - 62w x 88h x 48d mm • 5 Year Warranty

S 5307 **$49**

Ideal for the S 5495 Alarm Opposite

Amazing Bonus Package
Over $100 Value of Installation Accessories Including Cable, Strobe & Siren Free with Each Alarm System Purchase!

50 Metres of High Quality 6 Core Security Cable (Sufficient for average 4 bedroom house). W 0303



High Intensity Strobe S 5455

Siren Horn S 6130

2 Large Alarm Stickers - S 5400
Plus 4 Window Stickers - S 5410

ALTRONICS

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Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $9.50, 3kg to 5kg is $18.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs. **Insurance:** As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance". **Altronics Resellers:** Chances are there is an Altronics Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

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IR remote control for the Railpower Mk.2

This remote control gives you complete freedom of operation for the Railpower Mk.2 train controller. It has pushbutton control for everything & pulls negligible current when not in use.

By RICK WALTERS

As presented in the September & October 1995 issues, the Railpower Mk.2 is a walkaround throttle. It allows you to follow your trains as they go around the layout. As such, it performs very well. But perhaps you don't like being tethered by a remote control cable. If so, you will want this infrared remote control. It operates just like any other remote and is based on the same microprocessor used in the Railpower Mk.2.

The remote control handpiece has six pushbuttons but does not have the meter which was included in the walkaround hand control. Instead, we have designed a small PC board which has an array of 10 LEDs, to give an indication of train speed. This is mounted inside the main unit, along with a small PC board for the infrared receiver.

The remote control uses the same plastic case as for the walkaround hand control. It contains a small PC board (coded 09101961) and a battery. The board contains six pushbuttons, three transistors, one IC, one crystal and a few other components.

As you can see from the circuit of Fig.1, the battery is connected all the time, as is standard practice in all infrared remote controls. But instead of a dedicated IC as found in most remote controls, we have used a Z86E08 microprocessor.

To conserve the battery, we have used a feature which was not previously exploited. The Z86E08 is a CMOS device and normally does not draw much current but for battery operation, it can be put into a "sleep" mode, whereby the current it draws is

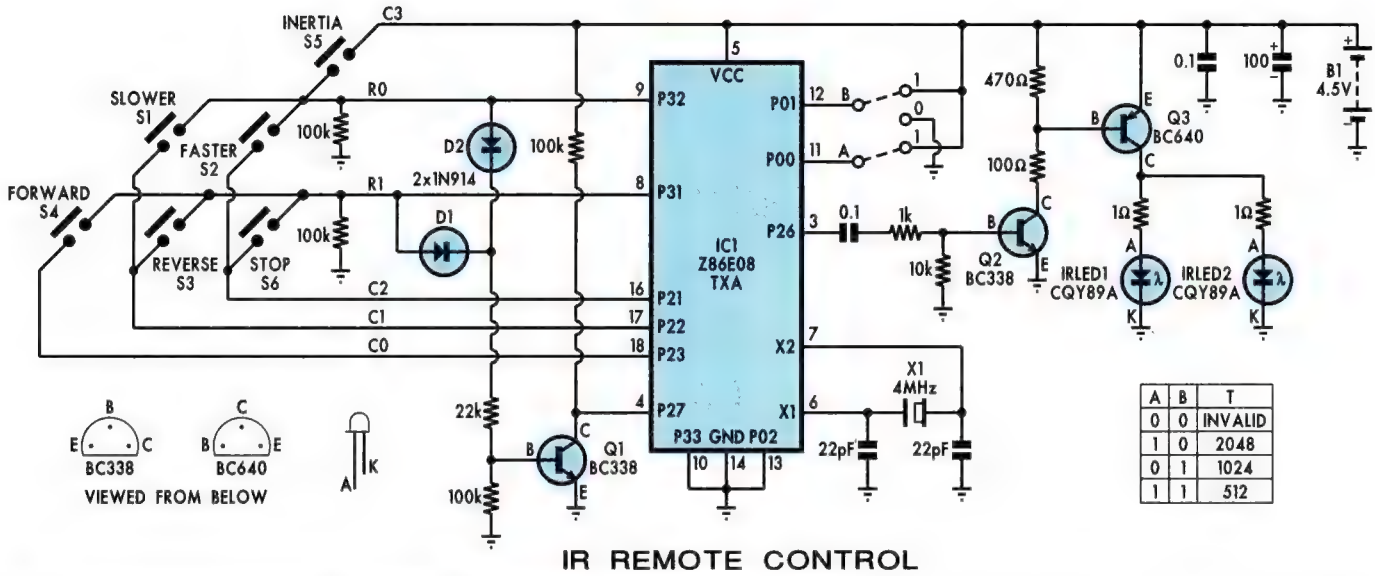


Fig.1: the transmitter circuit. This uses a Z86E08 microprocessor to produce coded IR pulses when the buttons are being pressed. When the buttons are not being pressed, the microprocessor goes into sleep mode to conserve the battery.

only 10µA. This greatly increases the battery life.

When IC1 is put to sleep. it takes pins 16, 17 & 18 high (ie, to the battery positive line, +4.5V). Later, when any button is pressed, R0 or R1 (ie, row zero or row one of the pushbutton matrix) will go high, turning on transistor Q1 via diode D1 or D2. Q1 pulls pin 4 of IC1 low, to "wake it up", after which it takes pins 16, 17 & 18 low and scans the buttons to see which one was pressed.

C3 (column 3), the input to the INERTIA button, is high and if this is pressed, pin 9 of IC1 will go high. If this button is not pressed the processor then takes pin 16 (C2) high. As you can see from the circuit, the STOP or FASTER button, if pressed, will take pin 8 or pin 9 of IC1 high and the code for this button will be sent. Pins 17 and 18 are taken high in sequence and if any of the remaining buttons are pressed, their code will be transmitted.

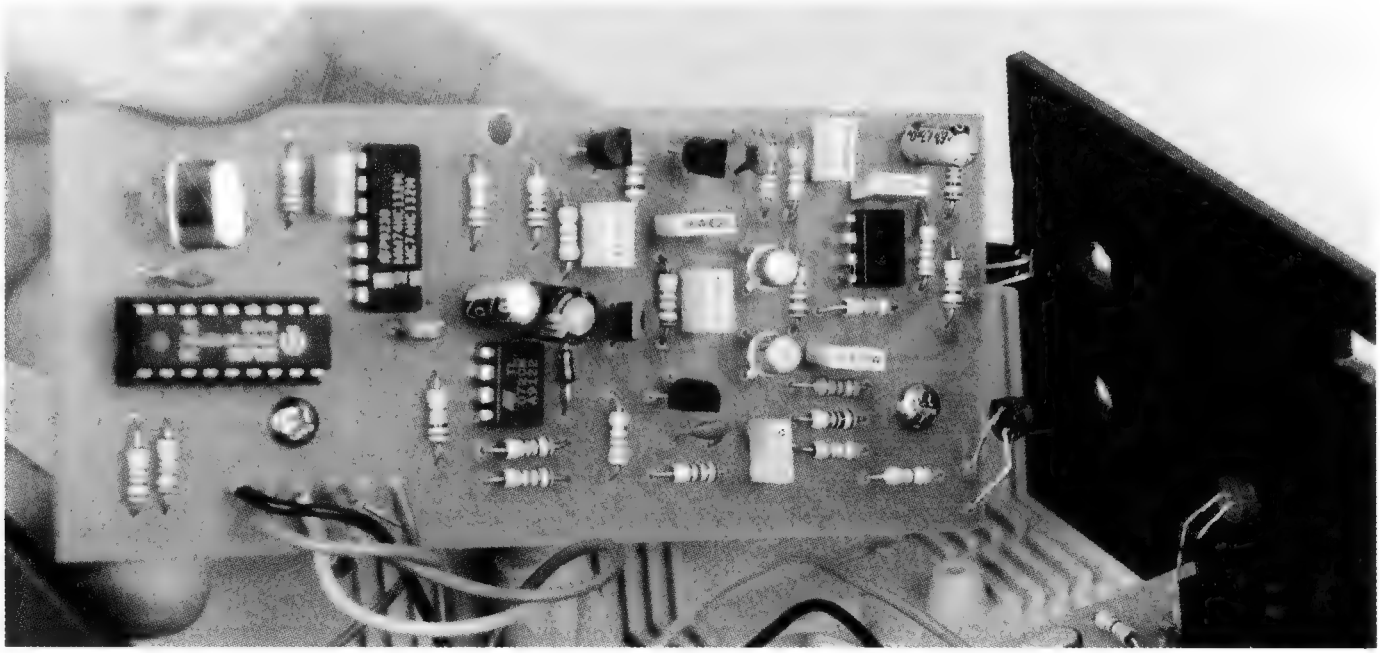
The pulse code appears on pin 3 of IC1 and turns Q2 and thus Q3 on and off. Q3 pulses two infrared LEDs (LED1 and LED2).

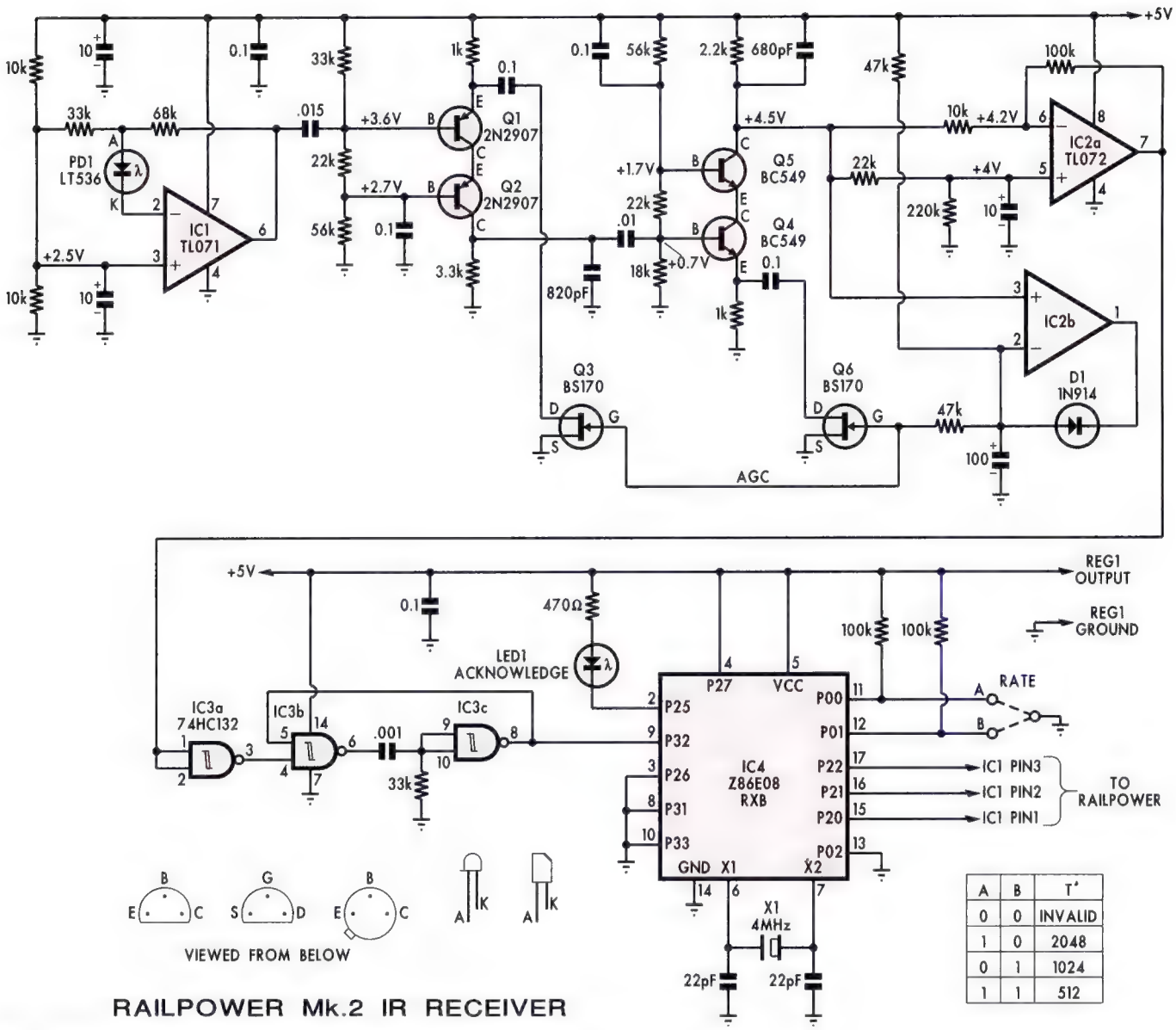
Remember, only one button is pressed at a time and the code for this button will be sent many times before you can release it. With the jumpers set on 1,1 a burst of code takes 20 milliseconds to be sent.

Each time the processor finishes a scan, it takes all column outputs high (C0-C3) and looks at the collector of Q1. If it is low, indicating a button is pressed, it will scan the buttons again; if high, it will go into sleep mode to conserve the batteries.

The RATE links A and B must be the same in the transmitter and the

Below: this photo shows the completed IR receiver board being installed in the Railpower case. Note the mounting details for the Acknowledge LED and the LT536 infrared diode (PD1).





A	B	T'
0	0	INVALID
1	0	2048
0	1	1024
1	1	512

Fig.2: the IR receiver circuit. This uses two cascode transistor stages (Q1, Q2 and Q4, Q5) with AGC to provide the necessary large gain for the photodiode signal. The signal decoding is done by IC4, a Z86E08 microcontroller programmed for this purpose.

receiver. These links could allow you to have one hand control with a 3-position selector switch and this could control three Railpower IR receivers, each with a different rate setting.

Infrared receiver

The infrared receiver consists of photodiode PD1, current-to-voltage converter IC1, two cascode transistor amplifiers (Q1, Q2 and Q4, Q5) with AGC (automatic gain control), a comparator and AGC detector (IC2), a pulse stretcher (IC3) and a data decoder, IC4. These are all mounted on a PC board (coded 09101962) which is housed in the case of the Railpower controller. The circuit is shown in Fig.2.

Photodiode PD1 sees the IR pulses emitted by the remote control and varies its current accordingly. This variation in current is converted to voltage pulses by op amp IC1 which drives the base of Q1 via a .015µF capacitor.

The pulses from IC1 can vary from around 0.2V peak-peak when the remote control is close to PD1 to being lost in the noise when it is some distance away. For this reason, we need a lot of gain for weak signals but not very much for the stronger ones. We obtain lots of gain by using cascode circuits and then we use automatic gain control (AGC) on both to cope with large signals.

Gain control

The two cascode circuits are similar, the first using PNP transistors Q1 & Q2, the second using NPN transistors Q4 & Q5. AGC is applied to the first pair by FET Q3, while FET Q6 applies AGC to the second cascode pair.

The gain of the first cascode stage, with Q3 turned off, is around 3.3 while the gain of the second stage, with Q6 turned off, is 2.2 giving an overall gain of 7.3 (3.3 x 2.2). With Q3 & Q6 turned on fully, the gain of each cascode stage can be in excess of 200, giving an overall gain of 40,000 or more for very small input signals.

PARTS LIST

Remote Control Transmitter

1 PC board, code 09101961, 85 x 50mm
1 plastic case (Jaycar HB-6032 or equivalent)
1 4MHz crystal (HC18, HC49)
2 yellow PC mount momentary switches (Jaycar SP-0722 or equivalent)
1 red PC mount momentary switch (Jaycar SP-0720 or equivalent)
1 black PC mount momentary switch (Jaycar SP-0721 or equivalent)
1 white PC mount momentary switch (Jaycar SP-0723 or equivalent)
1 green PC mount momentary switch (Jaycar SP-0722 or equivalent)
1 single AA cell holder (see text)
3 L1154 alkaline batteries
1 18 pin IC socket (optional)
4 #8 x 10mm self-tapping screws
4 5mm untapped spacers
1 100mm-length red wire
1 100mm-length black wire
1 50mm-length 1mm sleeving

Semiconductors

1 Z86E08 programmed TXA (IC1)
2 1N914 signal diodes (D1,D2)
2 BC338 NPN transistors (Q1,Q2)
1 BC640 PNP transistor (Q3)
2 CQY89A LED (or equivalent)

Capacitors

1 100µF 16VW electrolytic
2 0.1µF 50VW monolithic
2 22pF ceramic

Resistors (0.25W, 1%)

4 100kΩ	1 470Ω
1 22kΩ	1 100Ω
1 10kΩ	2 1Ω
1 1kΩ	

IR Receiver Board

1 PC board, code 0911X951, 120 x 50mm
1 4MHz crystal (HC18,HC49)
1 18-pin IC socket (optional)
2 3mm x 15mm threaded spacer
2 3mm x 10mm screw
2 3mm x 6mm screw
1 200mm-length black hook-up wire
1 200mm-length red hook-up wire
1 200mm-length orange hook-up wire
1 200mm-length yellow hook-up wire
1 200mm-length green hook-up wire

Semiconductors

1 TL071 op amp (IC1)
1 TL072 dual op amp (IC2)
1 74HC132 quad 2-input NAND gate (IC3)
1 Z86E08 programmed RXB (IC4)
2 2N2907 PNP transistors (Q1,Q2)
2 BC549 NPN transistors (Q4,Q5)
2 BS170 FET (Q3,Q6)
1 LT536 photodiode (PD1)
1 1N914 signal diode (D1)
1 5mm red LED (LED1)

Capacitors

1 100µF 16VW electrolytic
3 10µF 50VW electrolytic
6 0.1µF 50VW monolithic
1 .015µF 100VW MKT polyester
1 .01µF 100VW MKT polyester
1 .001µF 100VW MKT polyester
1 820pF disc ceramic
1 680pF disc ceramic
2 22pF capacitors

Resistors (0.25W, 1%)

1 220kΩ	1 18kΩ
3 100kΩ	3 10kΩ
1 68kΩ	1 3.3kΩ
2 56kΩ	1 2.2kΩ
2 47kΩ	2 1kΩ
3 33kΩ	1 470Ω
3 22kΩ	

Speed Display Board

1 PC board, code 09101963, 65 x 50mm
1 5kΩ horizontal trimpot (VR1)
1 1kΩ horizontal trimpot (VR2)

Semiconductors

1 LM3914 bargraph driver (IC1)
1 10-LED display (Jaycar ZD-1700)

Capacitors

1 10µF 50VW electrolytic
1 1µF 16VW electrolytic
1 0.1µF monolithic

Resistors (0.25W, 1%)

1 100kΩ	1 4.7kΩ
1 15kΩ	1 820Ω

1 15kΩ 9-resistor array (10-pin SIP)

Miscellaneous

Hookup wire, PC stakes.

In practice, the output signal from the collector of Q5 is monitored by IC2b which is connected as a peak rectifier. With no input signal present, pin 2 of IC2b is pulled high by the 47kΩ resistor connected to the +5V rail. Negative-going pulse signals at the collector of Q5 cause IC2b and its associated diode D1 to pull pin 2 towards 0V and hence discharge the 100µF capacitor. Thus, the gates of Q3 & Q6 tend to be taken high for small signals, to increase the gain. Conversely, large signals tend to result in the gates of Q3 & Q6 going toward 0V, to turn them off and reduce the gain.

In practice, the circuit continuously varies its gain so that the signal amplitude at the collector of Q5 is more or less constant.

Q3 & Q6 are connected to the emitters of their respective cascode stages via 0.1µF capacitors. This means that the gain of the cascodes increases at high frequencies but not at 50Hz or 100Hz, to reduce any interference from incandescent or fluorescent lights.

IC2a is connected as a comparator and compares the signal from the collector of Q5 with the DC voltage at its pin 5. It effectively squares up the signal pulses and removes any residual noise. IC2a drives IC3, a CMOS quad NAND gate which is used as a pulse stretcher. This allows us to supply a consistent pulse width to IC4, regardless of the output of IC2a.

Data decoder

IC4 is another Z86E08 microprocessor which has been programmed to accept the IR data transmitted by the hand control and convert it to the correct code on pins 15, 16 & 17 to operate the Railpower functions. The

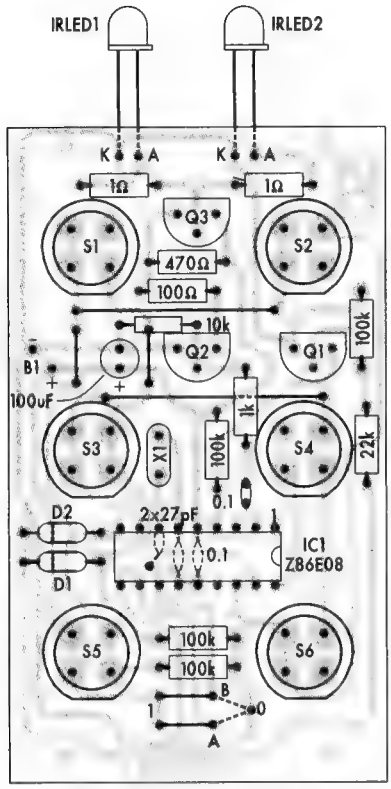
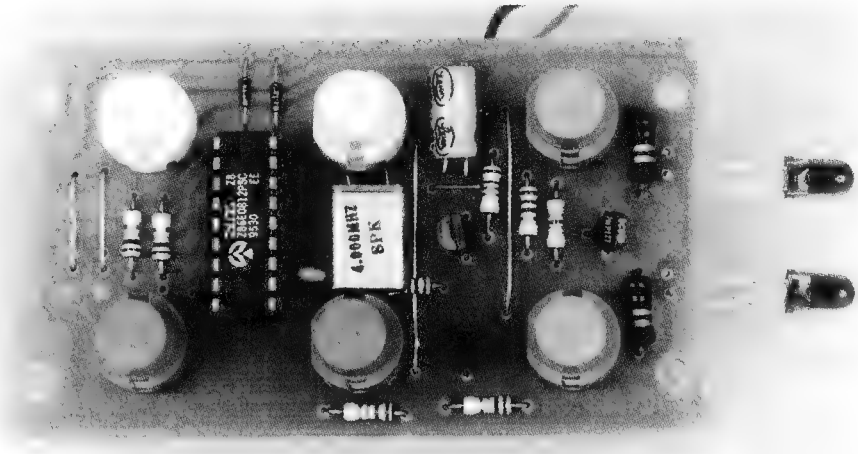
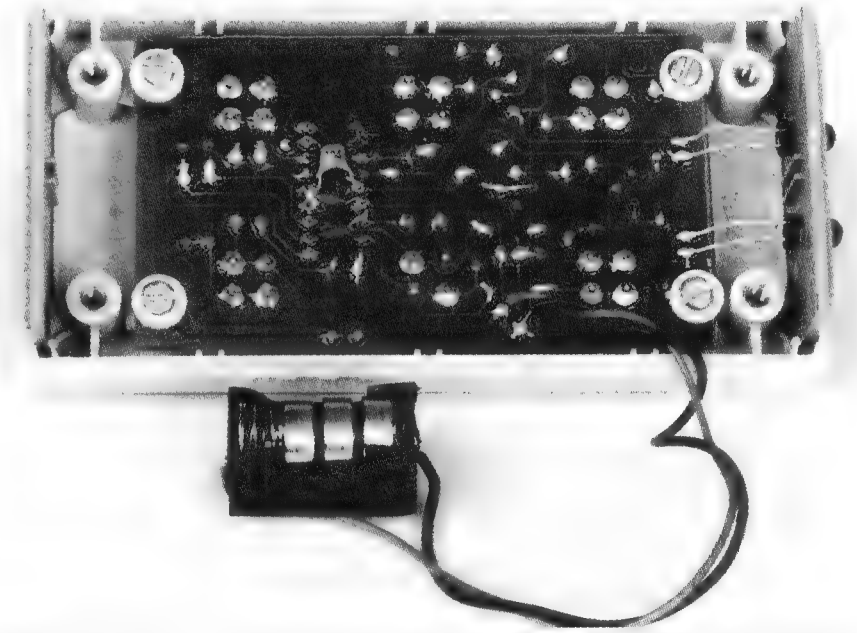


Fig.3: the component layout for the transmitter PC board. Note the three capacitors mounted on the underside of the board. These are shown dotted within the outline for IC1.



This topside view of the remote control transmitter board shows how the crystal is laid flat. Make sure that the two IR LEDs are correctly oriented.



This view inside the completed transmitter shows the mounting details for the three capacitors on the copper side of the board. Note the modified AA cell holder for the three button cells.

microprocessor stores two consecutive codes from the transmitter and compares them. If they are identical, it will send the information to the Railpower; if they differ, it will ignore them and compare the next two codes received. As mentioned previously, the rate links on the receiver must be the same as those on the transmitter.

The three output lines from IC4 are

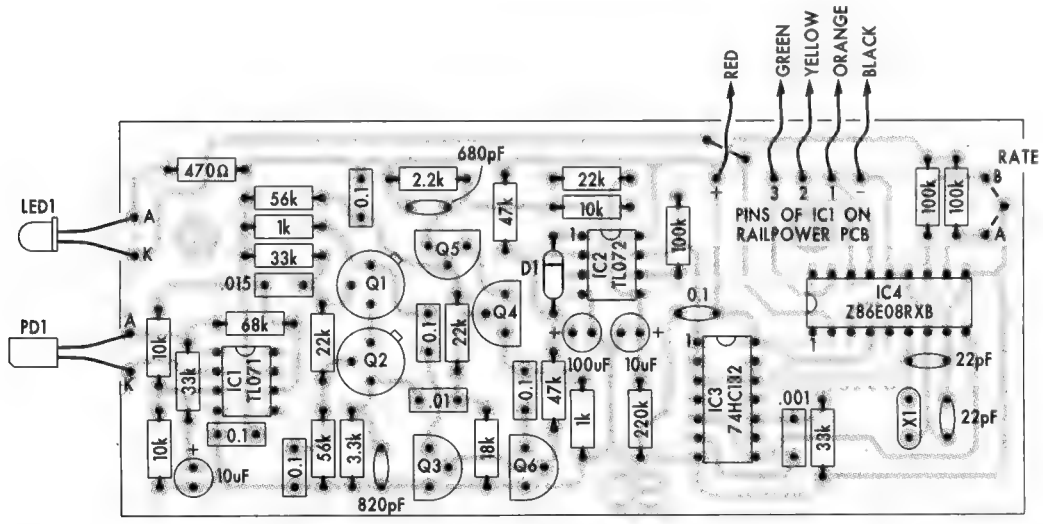
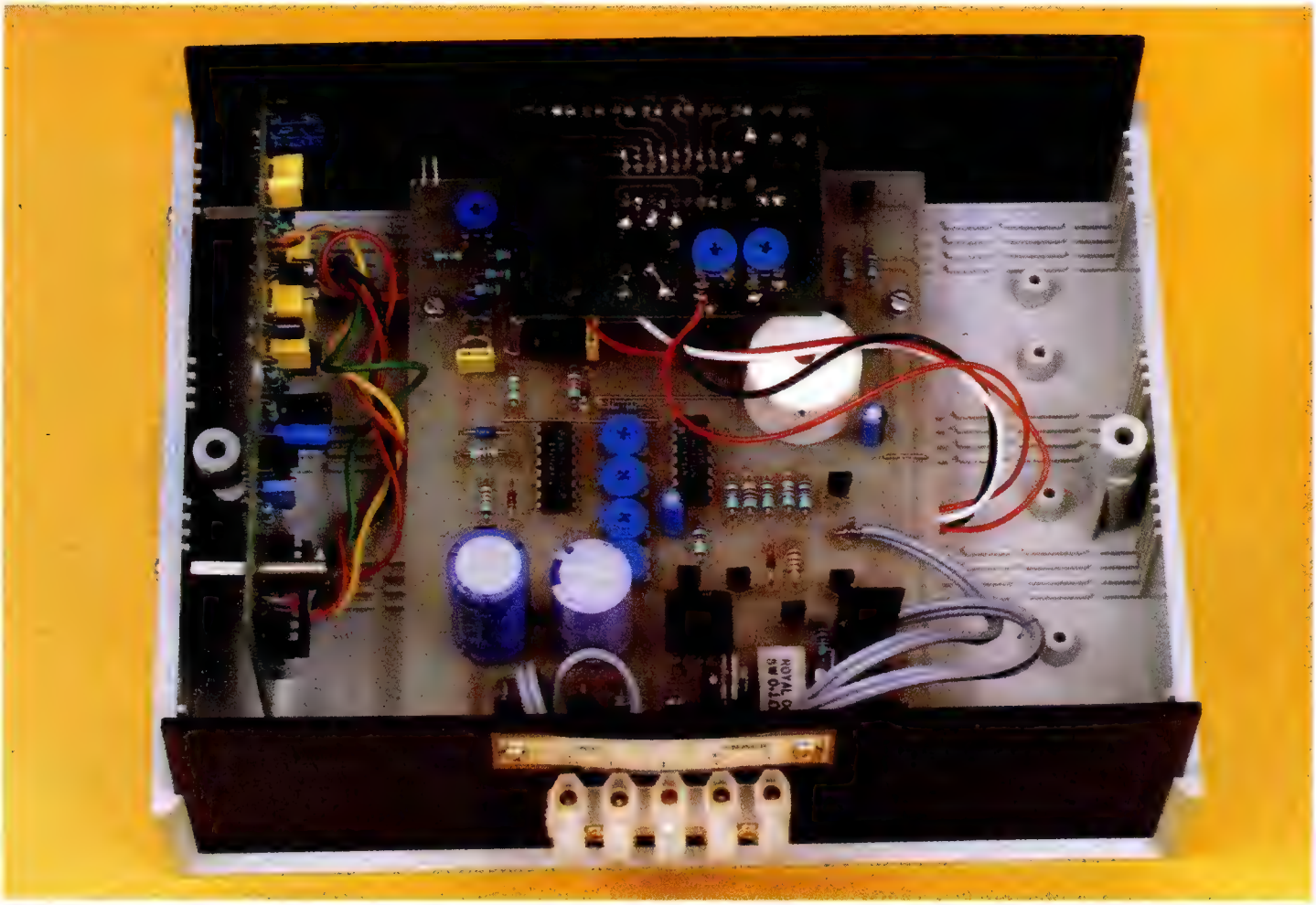


Fig.4: the component overlay for the IR receiver board. Note that the rate links on this board must match the rate link settings on the transmitter PC board.



This view shows how the IR receiver board is mounted vertically along one side of the Railpower Mk.2 case, while the speed board is mounted upside down, with the LEDs protruding through the front panel.

RESISTOR COLOUR CODES

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	220kΩ	red red yellow brown	red red black orange brown
❑	8	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	68kΩ	blue grey orange brown	blue grey black red brown
❑	2	56kΩ	green blue orange brown	green blue black red brown
❑	2	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	3	33kΩ	orange orange orange brown	orange orange black red brown
❑	4	22kΩ	red red orange brown	red red black red brown
❑	1	18kΩ	brown grey orange brown	brown grey black red brown
❑	1	15kΩ	brown green orange brown	brown green black red brown
❑	4	10kΩ	brown black orange brown	brown black black red brown
❑	1	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	1	2.2kΩ	red red red brown	red red black brown brown
❑	3	1kΩ	brown black red brown	brown black black brown brown
❑	1	820Ω	grey red brown brown	grey red black black brown
❑	2	470Ω	yellow violet brown brown	yellow violet black black brown
❑	1	100Ω	brown black brown brown	brown black black black brown
❑	2	1Ω	brown black gold gold	brown black black silver brown

Adding A Speed Meter To The Railpower Mk.2

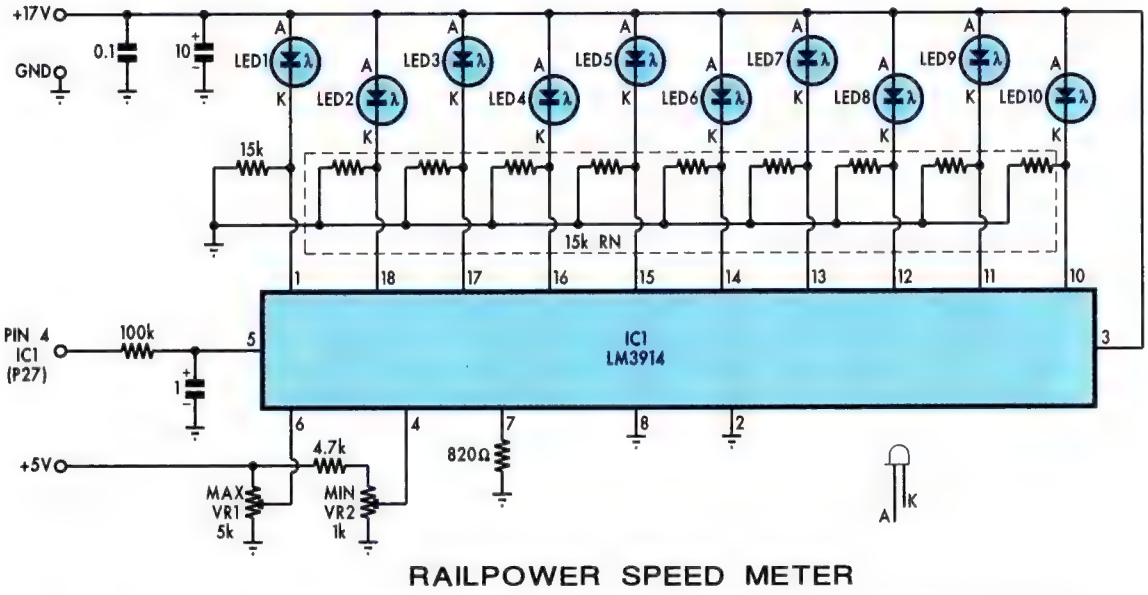


Fig.5: the speed meter is a conventional LM3914 LED bargraph circuit. It takes the place of the analog meter in the original walkaround control for the Railpower Mk.2.

If you wish to add a speed meter to the Railpower Mk.2, then use the LED bargraph display we have designed. It sits above the LED indicators on the front panel of the main unit and consists of a bar of 10 red LEDs. It is a standard circuit employing an LM3914 LED bargraph display driver. The two preset potentiometers on this board are adjusted in a similar manner to the meter setup in the hand control. The circuit is shown in Fig.5 while the component overlay for the PC board (coded 09101963) is shown in Fig.6.

Fit the IC, SIP and resistors, then the capacitors and potentiometers. If you wish, you can solder the potentiometers on the copper side of the board, as we have done, to make them easy to adjust.

Connect a red wire to the +17V, orange to the +5V, black to the ground and yellow to the input terminal, as shown on the layout. The other end of the red wire connects to +17V on the main board (REG1 input), the orange to +5V (REG1 output) and the black wire to ground. The other end of the yellow wire should be soldered to pin 4 of IC1 (top of VR5).

Calibration

Once the maximum and minimum speeds have been set satisfactorily on the main Railpower PC board, FORWARD should be set-

connected to IC1 in the Railpower unit.

Construction

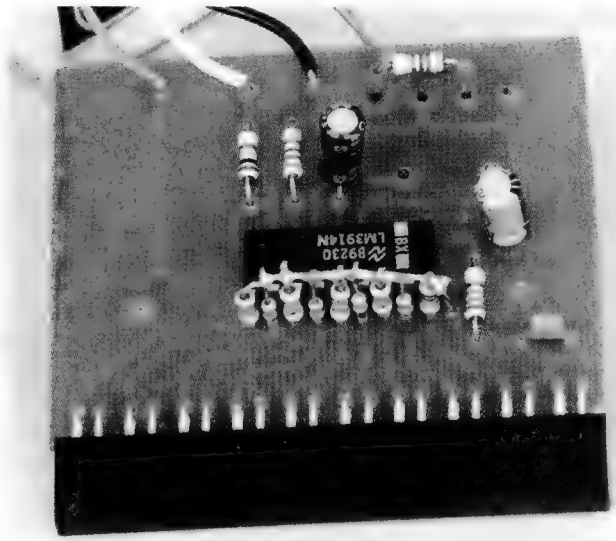
In discussing the construction, we will assume that you have already built the Railpower Mk.2, as described in the September & October 1995 issues. We will also assume that you have built up the original wired hand control and have made everything function as described in the setup procedure.

To add the infrared remote control, you need to build the remote control handpiece and the IR receiver board. As mentioned previously, we have also designed an optional LED bargraph speed indicator which takes the place of the speed meter in the original walkaround hand control.

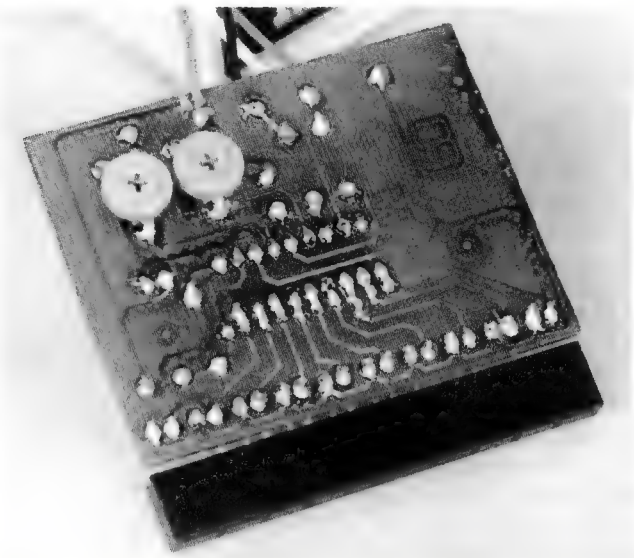
Let's start with the remote control transmitter PC board. Its component layout is shown in Fig.3. Check the board for open circuit tracks or shorts, especially the track that passes between pins 7 and 8 of IC1. While you're at it, check the other two boards for any etching problems and make any fixes as required.

The first step is to mount the blank board in the plastic case. It goes in the half with the brass inserts (the front), with the copper side of the PC board facing up. A small hole has been drilled at the centre of each group of four pushbutton pads to allow you to drill pilot holes through into the case front for the six pushbuttons. When you have drilled them, remove the board from the case. (By the way, these pilot holes are not present in the photo of our prototype).

Fit the two long and two short links at the LED end of the board and the



This assembled speed meter shows nine discrete resistors instead of the specified SIP resistor array.

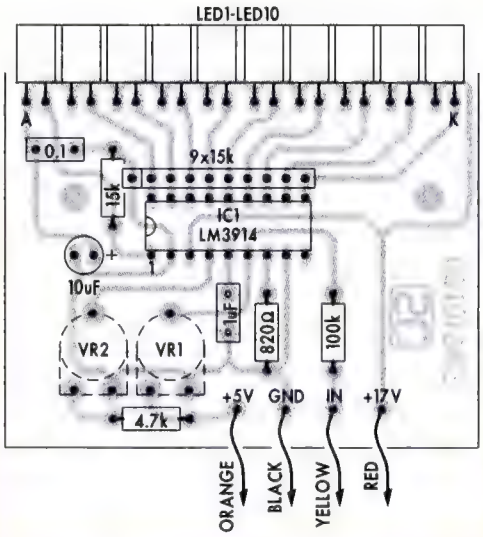


The two adjustment pots are mounted on the underside of the speed meter board for easy access.

lected and the minimum pot (VR2) on this board set so that the first LED lights. The controller should then be taken to full speed and the maximum pot (VR1) adjusted so that LED number 10 is lit. There is a small amount of interaction and the adjustments may have to be made several times to get it right.

As an alternative to the speed bargraph, there is no reason why you could not mount the original walkaround control meter in the front panel, fitting a meter zero adjust control the same as in the handpiece and taking the positive meter wire to pin 2 on the DIN socket.

Fig.6 (right): install the parts on the speed meter PC board as shown in this wiring diagram. Check that all the LEDs are correctly oriented and note the mounting details for VR1 and VR2 (see photo above right).



two rate links. We suggest you initially code it 1,1 as shown on the overlay, as this gives the fastest transmission rate. Next, fit and solder the diodes and resistors, followed by the transistors, capacitors and crystal. Push the transistors well down so that they are only about 2mm off the board. Bend the crystal's leads at right angles and lie it down flat. The electrolytic capacitor should also lie flat on the board.

Lastly, fit the pushbuttons, noting that all the flats face in the same direction (towards the rate links). Do not fit the LEDs as this will be done later. If you elected not to use an IC socket, fit and solder the IC marked TXA (this Z86E08 has been programmed as the transmitter); otherwise, solder in the IC socket. In either case, be sure to check the orientation of pin 1.

As the PC board is rather small, we elected to mount three capacitors on the copper side. These can be fitted now. The 0.1µF monolithic type is soldered from pin 5 to pin 14, then laid flat against the board towards the pin 1 end. The two 22pF capacitors are soldered from pin 6 to pin 13 and from pin 7 to the pad on the copper track between pin 13 and pin 10. Both are laid flat, facing towards the other end of the socket. These details can be checked in the relevant photo.

Battery holder

The battery consists of three 1.5V button cells in series. These are held in a half-sized holder made out of a single AA cell holder. Cut the battery holder in half with a saw or sharp knife about 28mm from the spring end. Our holder had a moulded ridge at this point. Carefully cut the non-

spring plastic end out of the holder and locate it in the piece with the spring to make a half-size unit. The easiest way to retain the end is to melt the plastic with your soldering iron. If you do this inside and out, the end will be held firmly in place. Alternatively, you can do a neater job if you have access to ACC adhesive as used in plastic model making). Solder a red wire to the spring end and a black wire to the other end, then connect the red to the positive supply terminal on the PC board and the black wire to the negative terminal.

Now drill one of the case end pieces to take the IR LEDs. Drill two 5mm holes on the horizontal centreline and 7.5mm either side of the vertical centreline. Slip 10mm of 1mm-dia. sleeving over each long LED lead, sit the PC board and LEDs in the case and bend the leads so that 2-3mm of each LED protrudes through the end piece. The longer sleeved lead should be on the right when viewed from the component side.

Once you are satisfied, solder in the LEDs, insert the IC if you used a socket and fit the board in the case using the self-tapping screws and spacers. The battery holder can be kept in place with a dab of BLU-TACK® adhesive.

Receiver board

The component layout for the receiver board is shown in Fig.4. Start by fitting the one link and the resistors. Next, fit the ICs, using a socket for IC4 if you prefer. Make sure that all the ICs are correctly oriented. This done, solder in the MKT capacitors, the transistors, electrolytic capacitors and finally the crystal. Don't mount PD1 or the acknowledge LED yet.

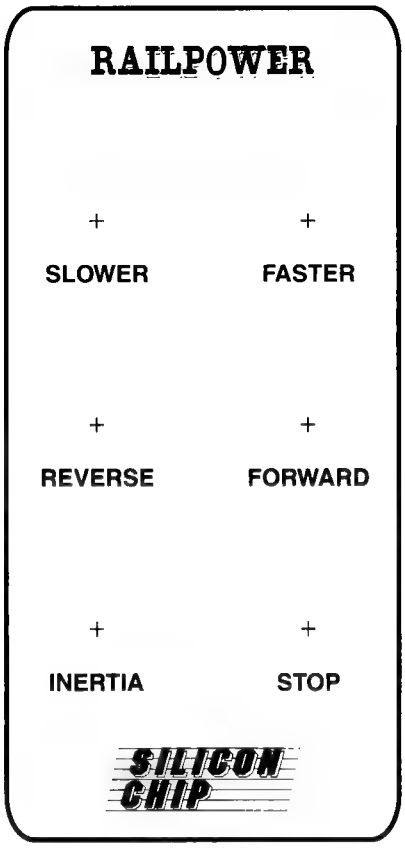


Fig.7: the full-size artwork for the remote control front panel.

Fit 200mm lengths of hook-up wire to the board, in the wire colours as shown in Fig.4, for the signal output and supply connections. This done, mount the PC board in the righthand side of the Railpower case, using two tapped metal spacers.

Drill two 5mm holes in the front panel for the photodiode and acknowledge LED. File the hole for the photodiode to a 5 x 7.5mm rectangle, then replace the panel and bend the LED leads so that it protrudes satisfactorily through the front panel. Locate the sensor centrally behind the rectangular cutout. Both anodes (longer lead) are towards the top of the PC board. When you are satisfied with their positions, solder them both in place.

Solder the black wire to the centre pin of REG1 (ground) and the red wire to the output pin of REG1 (+5V). The orange wire should be soldered to pin 1 of IC1, the yellow to pin 2 and the green to pin 3. Reassemble the unit and after applying power, check that the walkaround control still operates. If it doesn't, the most likely cause is a short between pins 1, 2 or 3 on IC1.

Testing

Clip the three cells into the holder on the IR remote control unit, observing their polarity. They are back-to-front compared to standard cells, the small cap being the negative connection. Point the remote control at the receiver and press a button. If all is well, the acknowledge LED on the Railpower should light and the corresponding function should be indicated by the Railpower LED.

If it doesn't work, the problem is knowing which unit is not operating correctly, the transmitter or the receiver.

First, check that the battery voltage is around 4.5V on the transmitter. If you have an oscilloscope, hold a button down and check pin 7 of IC1 to see that the crystal is oscillating at 4MHz. Now check at the anode of one of the transmitter LEDs. There should be a pulse train output whenever a button is pressed. If the pulses are being sent continuously, then one of

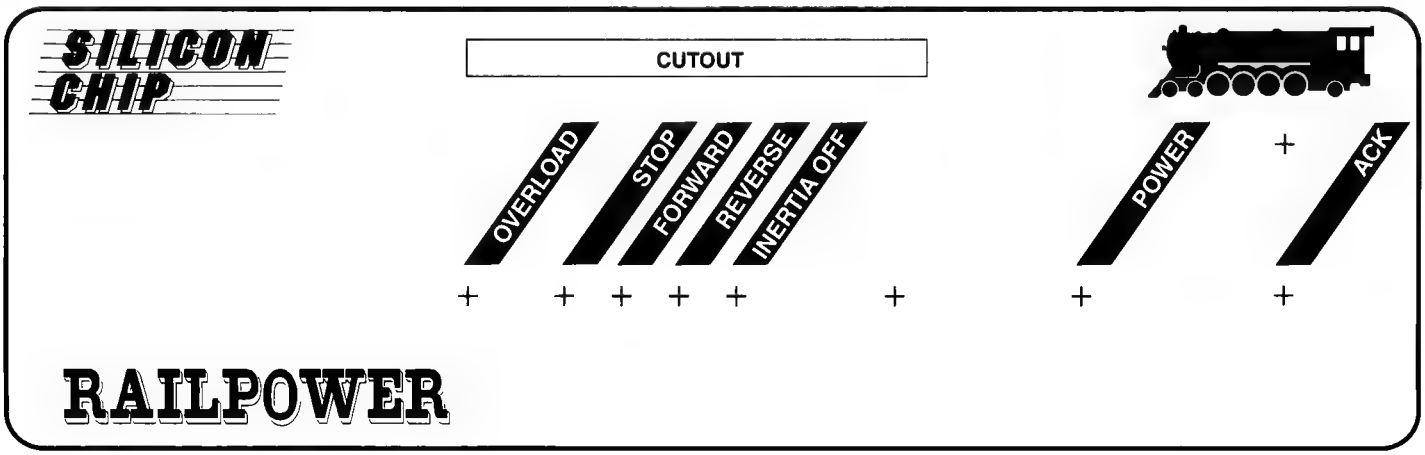
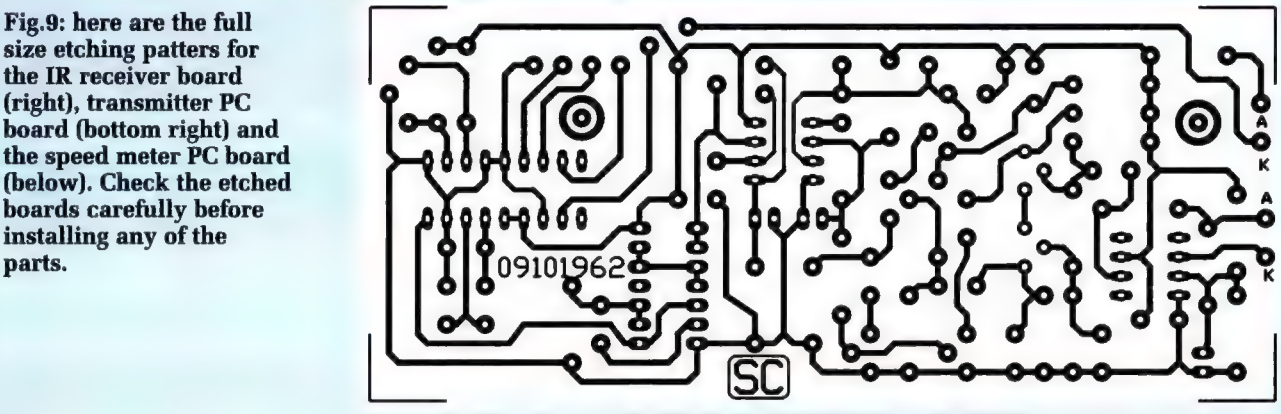
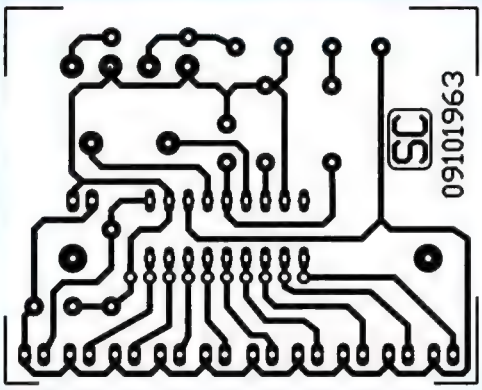
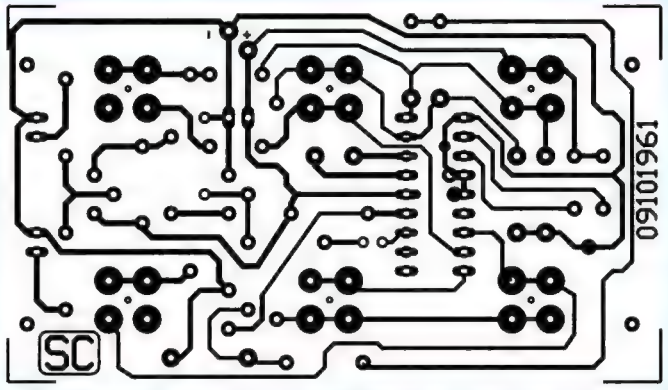


Fig.8: this is the full-size front panel artwork for the remote control version of the Railpower Mk.2.

Fig.9: here are the full size etching patters for the IR receiver board (right), transmitter PC board (bottom right) and the speed meter PC board (below). Check the etched boards carefully before installing any of the parts.







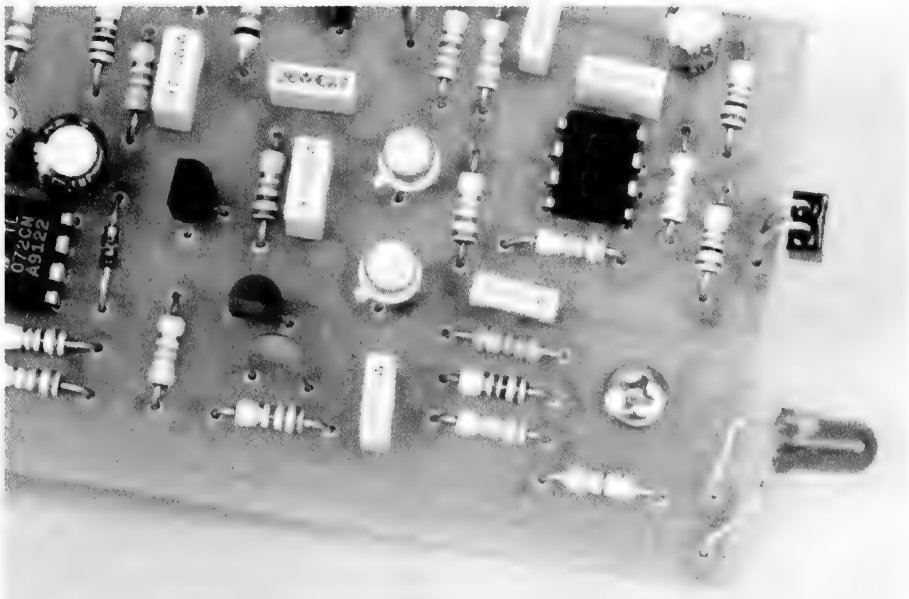
the pushbuttons has been inserted incorrectly.

If an oscilloscope is not available, remove the batteries and connect a DC power supply set to 4.5V. When a button is pressed, the current should be around 9mA. As soon as the button is released, the current should drop to about 5mA and after one second drop to 100µA. If this occurs, you can assume that the transmitter is working satisfactorily. If not check the capacitors on the crystal pins.

IR receiver board

On the receiver, check that pin 14 of IC3 is at +5V with respect to pin 7. If you have an oscilloscope, check pin 7 of the processor to confirm that the crystal is oscillating at 4MHz. Hold the transmitter close to the receiver with a button pressed. The output at pin 6 of IC1 should be a negative-going pulse of several hundred millivolts. It should be positive-going at Q2's collector and 3-4V negative-going at Q5's collector.

The output of IC2a (pin 7) should be positive-going, while the signal into pin 9 of IC4 should be a negative-going 5V pulse 33µs wide.



This close-up view shows how the leads of the infrared photodiode (PD1) on the receiver are bent over, so that the active surface of the device faces the hole in the front panel.

If you don't have an oscilloscope, the best approach is to compare the DC voltages measured in your receiver with those shown on the circuit. They should be within 10% of each other. If there is a discrepancy, check the component values around the relevant stage and also your soldering.

Check also that the A and B rate links on the transmitter and receiver match each other. If they don't, the remote control won't work. **SC**

SERVICEMAN'S LOG

The complaint seemed simple enough

Yes, it did sound simple. And, relatively speaking, it was. The trouble was, it didn't stop there – it had brought all its gremlin mates along with it. By the time I'd knocked them all over, it was a major exercise.

This story concerns a Sanyo colour TV set, model 6627 (79P chassis), which lead me a merry dance with a succession of faults – these in addition to the original complaint.

The set belongs to a pensioner, one of several among my regular customers, and whom I regard as being in something of a special category. In general, their equipment tends to be older than average, for the very simple reason that, for many, the cost of new equipment is almost prohibitive. So they keep their old units and call on me to keep them going for as long as possible.

Of course, I do my best to help them, even though at times it taxes one's ingenuity and patience. (After all, I'll be old myself someday – and no editorial comment, please). Anyway, this case was a classic example of this sort of job and, as is typical, involved a set that was over 10 years old.

But the owner's complaint seemed simple enough – distorted sound. And a quick check while he was there confirmed the complaint; the distortion was quite bad. Even so, I reckoned it should be a snack; that I would be able to knock the job over in no time. And that, as the reader has doubtless guessed, was where I came a gutser.

Sound circuitry

The sound section in this set is quite straightforward – see Fig.1. It consists of a sound IF amplifier and demodulator IC (IC151), the latter feeding two output transistors, Q151 and Q152. These are both specified as 2SC2568 or 2SC2456.

My first step was to check the 220V main HT rail, which came up spot on, as did several secondary rails derived from it. OK, so where to in the sound section? My first inclination was to suspect one of the two output transistors and, with more haste than wisdom, I whipped them out and tested them.

They both tested OK, which served me right for rushing in. I then did what I should have done first – checked the voltages around these transistors. And, yes there was something wrong. The base voltage of Q151 is shown on the circuit as "80V-106V", which seemed an unusually large spread. But that was largely academic anyhow, because the actual voltage was way down on even the lower figure.

And this was where I encountered the first of several discrepancies between the set on the bench and the circuit. And I don't meant bodgie repairs; I'm referring to original components. The bias resistor for Q151 (R151) is shown as 39kΩ but the one in the set was 27kΩ. Or, more correctly, it was coded 27kΩ. In fact, it measured over 100kΩ.

Well that seemed like the answer and I promptly fitted a new 27kΩ resistor. That brought the voltages back to within tolerance of those on the circuit and wiped out most of the distortion. And I say "most" because there remained a niggling level. It was nothing like the original but it was enough to indicate that there was still something wrong.

And that's just about the nastiest kind of fault I can imagine. It was at such a level that, at times, on certain program material, one could kid oneself that it wasn't there. Then the program would change and it was all too obvious. There was nothing for it; it had to be found.

So, with all the stage's operating voltages restored to normal, where should I go from here? The IC seemed the next most likely culprit. I had one on hand and changing it was not a particularly difficult job. But, alas, I drew another blank.

Down to basics

It was time to really get down to basics. I went right over the output

THE SERVICEMAN 40 YEARS AGO

stage and, by one means or another, checked each component in turn. And in the process, I encountered another circuit discrepancy; a diode, D153, which was in the set but not on the circuit. It has been drawn in on the circuit shown here.

I paid particular attention to electrolytic capacitors C151 (1µF) and C157 (2.2µF on the circuit, 4.7µF in the set). Low value electrolytics are always suspect. But these and all the other components, except one, were cleared.

That one component was C153, a 5600pF capacitor connecting to pin 13 of the IC. And I had left it until last because, initially, I couldn't identify it. I had been looking for a small ceramic capacitor or something similar but without success. In the end, I had to trace the copper pattern and, when I found it, it was quite a surprise.

It wasn't a ceramic capacitor and it wasn't 5600pF. It was an electrolytic and it was 0.47µF; the biggest change from the original circuit I had found so far. More to the point, being an electrolytic – and of very low value to boot – it was a prime suspect and I lost no time in reefing it out and fitting a new one.

And that was the answer, with the set now producing clean sound. And to confirm it, the suspect electrolytic showed substantial leakage when tested. So that looked like the end of the exercise. I gave the set the usual once over for general performance and minor adjustments, then set it up on the end of the bench and let it run.

The set carks it

Initially, it ran for several hours and then, suddenly, I was aware that it was completely dead, with no picture and no sound. Well, I took another punt: the horizontal output transistor (2SD838 on the circuit, 2SD621L in the set). And I picked it in one; it was short circuit.

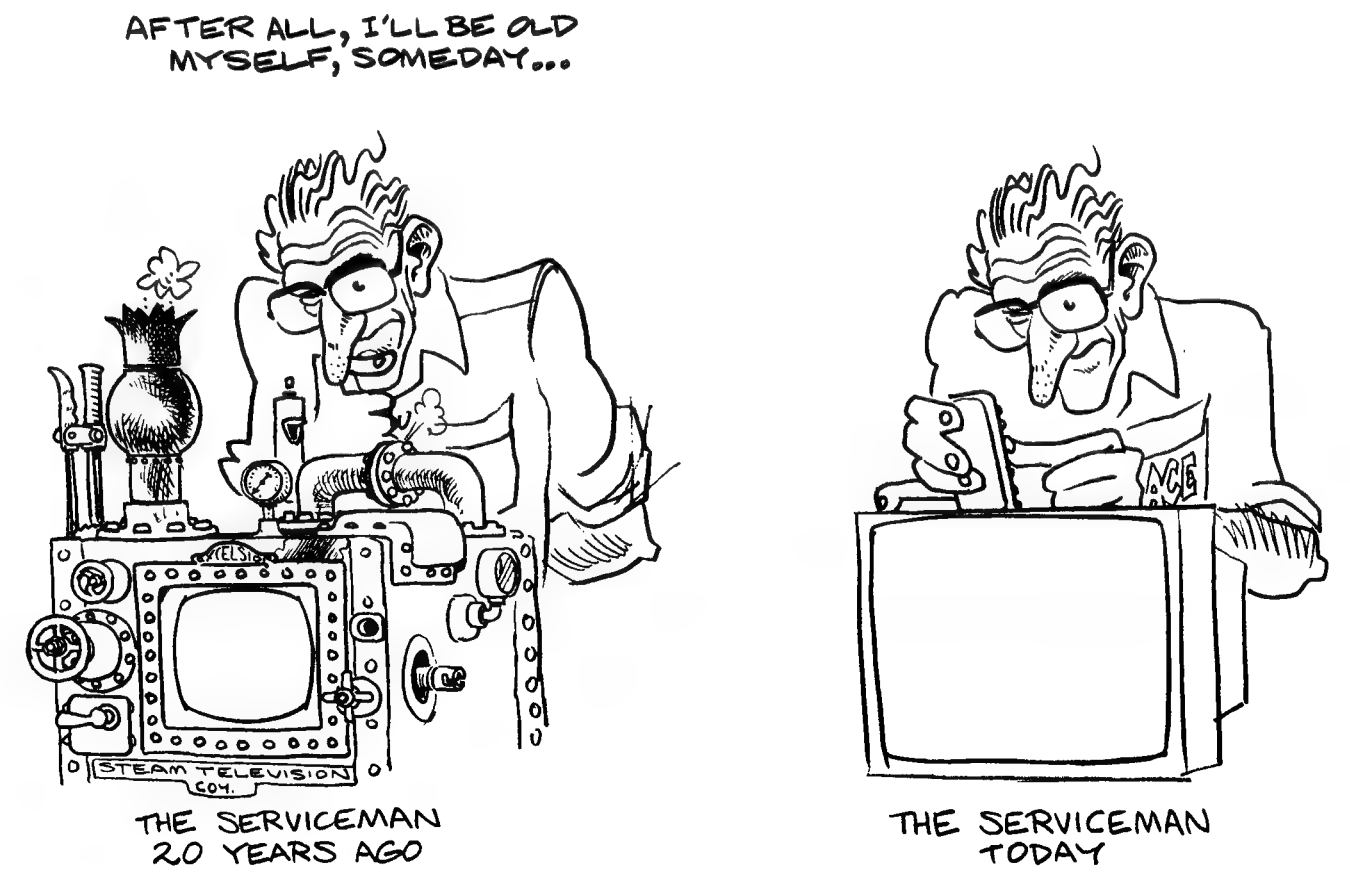
This failure, in itself, did not present any real problem, except that the 2SD838 was cheaper – at around $30 – than the 2SD621L ($42) but was no longer available. It was something of a slug for a pensioner but that's life.

More importantly, I was concerned as to why the transistor had failed. It has a pretty hard life in this set. The waveform shown on the collector is 1900V p-p which is high by any standards. That means that the stage is vulnerable to any spikes or rubbish on the driving waveform. And from experience, the most likely cause is a failure in C483, a 1µF electrolytic, which decouples the 220V rail to the horizontal drive transistor, Q481.

Again, experience has shown that this capacitor dries out, allowing all kinds of rubbish to reach the driver. So I pulled it and replaced it. And, as an attempt at insurance, I upped the value to 10µF. I can't guarantee how much it will help but it won't do any harm.

When I switched the set on again, there was sound but no picture. So what on earth could be wrong now? My first reaction was to suspect the operating voltages on the picture tube. I fished out the probe and checked the EHT. There were plenty of volts there, something over 25kV, and so I checked the screen voltage, focus voltage and the RGB drive transistors. All seemed OK.

I have experienced trouble in the past around transistor Q191. This forms part of the ACL (Automatic Contrast Limiter) circuit and the problem concerns resistor R197 (220kΩ) which goes high. And while the trouble had never been anything like this, I checked it, found it somewhat high



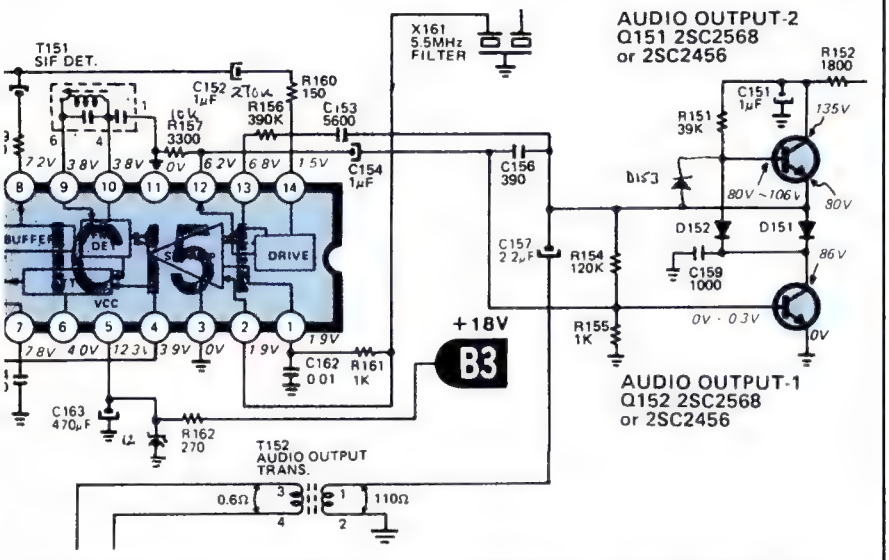


Fig.1: the audio output stage in the Sanyo 6627. Note the additional diode (D153) which has been drawn in between the base and emitter of Q151. As well, R151 is now 27kΩ, C157 is now 4.7μF and C153 (top left) is now a 0.47μF electrolytic.

and replaced it. But I wasn't surprised when it had no effect.

Next I did a waveform check, right through the video chain, but could find nothing wrong. I stopped and had a think and a caffeine fix and went over the checks I had made.

And suddenly I became suspicious. I realised that all the voltages I had measured – EHT, screen, focus, RGB, etc – had all been marginally high. I hadn't taken as much notice of this as I should have, the complete picture failure suggesting a total loss of voltage somewhere.

Now I went back to taws – the main HT rail. And there was the answer, or part of it. Instead of the previous spot-on 220V, it was now 275V. It was only a symptom but it was a start. I went straight to the power supply and, after a few preliminary checks, attacked Q901, the power regulator. And that was it; it was short circuit.

I fitted a new one and switched on. And everything came up roses; 220V on the HT rail and a picture on the screen.

And that was the end of the drama. But why did the excessive HT rail voltage create the effect it did? Frankly, I don't know. I considered a number of likely reasons – including the possible action of an over-voltage protection circuit somewhere in the system – but I'm afraid I was too fed up with the set to want to spend any more time trying to find out. I let it run for another day or so, then called the customer to come and collect it. And I was glad to see the back of it.

Granted, I was lucky in one way. At least those secondary faults occurred while the set was still on the bench. If I had returned the set immediately after fixing the first fault – as I might have done had the customer been in hurry – then I would have had it bounce. And that can generate bad will on the part of the customer.

So let's be thankful for small mercies.

The crook Telefunken

My next story is about a Telefunken colour set. It used an ICC4 chassis and while it had its problems, it wasn't quite the headache of the previous story.

The set came from a colleague. He passed it over to me for a couple of reasons. First, he is not particularly keen on servicing European sets and, second, he was rather snowed under at the time and didn't want to be caught with something that might take up a lot of time. And I gathered that it had been through several other organisations before it came to him.

The complaint was quite straightforward; it was completely dead. Fortunately, my colleague had a circuit, although it was a trifle grotty in places. And so I let myself be saddled with the monster.

It was quite an elaborate set, with most of the modern features: a very impressive remote control system, Teletext, and so on. As with any dead set, the first thing to check is the rail voltages and, by implication, the power supply. So I went straight to the power supply. And, yes, it was completely dead.

The supply itself is a fairly standard switchmode arrangement, the main difference being that, in order to accommodate the remote control on-off function, the supply runs continuously while ever the power point is on. The set itself is turned on or off via its 12V rail and this comes from IP61, an LM317T adjustable 3-terminal regulator. This regulator is in turn controlled by a signal from pin 7 of IR25.

In addition to the aforementioned 12V rail, there is also a 13V rail, a 22V rail and a 90V rail, the latter being the main supply rail. And, at first glance, there also appears to be a 17V rail emanating from the chopper transformer (UP40).

In fact, this is something of a furphy; the 17V rail is actually generated at pin 10 of the horizontal output transformer and this apparently takes over from the 13V rail (which feeds the regulator) once the horizontal stage fires up. (Note the arrow configuration on the 17V block).

No voltage

More to the point, there was no voltage on any of these rails. I moved over to the primary side of the chopper transformer (UP40). There was voltage out of the bridge rectifier and, in fact, this was applying some 350V across the main filter capacitor (CP11 – 100μF). I traced this through the primary winding, pins 9 & 1, of the transformer to the collector of the chopper transistor, TP32.

I subsequently spent some time checking likely components around this stage but could find nothing wrong. But I did make one useful observation. With the CRO connected to the waveform points indicated on the circuit, I found that, at the moment of switching on, there was a very brief indication of activity but the waveforms vanished almost immediately. The stage was trying to oscillate but couldn't continue.

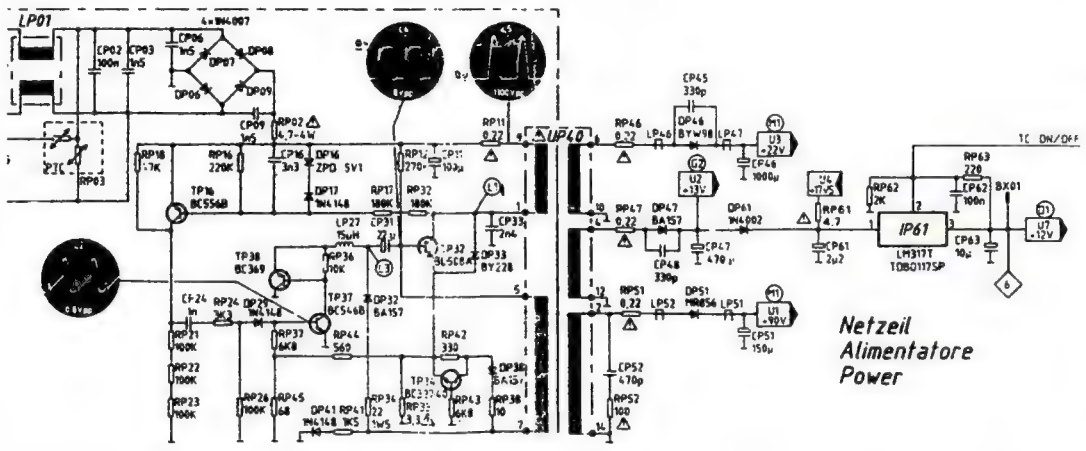


Fig.2: part of the switchmode power supply in the Telefunken ICC4. IP61 is an LM317 adjustable 3-terminal regulator which produces a +12V rail. This +12V rail is switched off (to turn the set off) when the main control IC pulls pin 2 of the regulator low (via a transistor).

This started a different train of thought. Perhaps there was a short circuit or overload on one of the rails which was placing an unacceptable load on the power supply?

First, I checked each rail with the ohmmeter but found nothing suspicious. This was not conclusive of course – there could still be a breakdown or leakage at the operating voltage, which would not show up with an ohmmeter check. I also checked the diodes supplying each of the rails. Again I drew a blank.

Next, I checked the horizontal output transistor, TL37 (BU508A), which connects to pin 2 of the horizontal output transformer (UL65) and thence to the 90V rail via pin 6. This checked out OK.

On the basis of all these tests, and assuming that the overload theory was still a valid suspicion, the next obvious step was to disconnect each of the rails in turn. I started with the 90V rail by disconnecting the 0.22Ω safety resistor, RP51, at pin 2 of UP40.

As it turned out, this was the wrong way to do the right thing. It was right because the power supply now showed signs of life. Each of the other rails now came up, partially and briefly, and then died away. (On reflection, I suspect that the aforementioned weird 17V rail configuration had something to do with this strange behaviour).

Unfortunately, disconnecting the rail at that point was the wrong way to do it, because it was directly on the transformer pin and did not allow me to check the 90V rail itself.

I restored the 0.22Ω resistor and went back to the horizontal stage. This is a very complex arrangement and difficult to follow, both in the set and on the circuit. But the 90V rail goes to a choke (LL54), through diode DL56, and thence to pin 6 of the horizontal output transformer via LL57. And LL54 provided a convenient place to break the 90V rail and check it.

In fact, it did come good, in a similar manner to the way the other rails had responded. The trail was getting

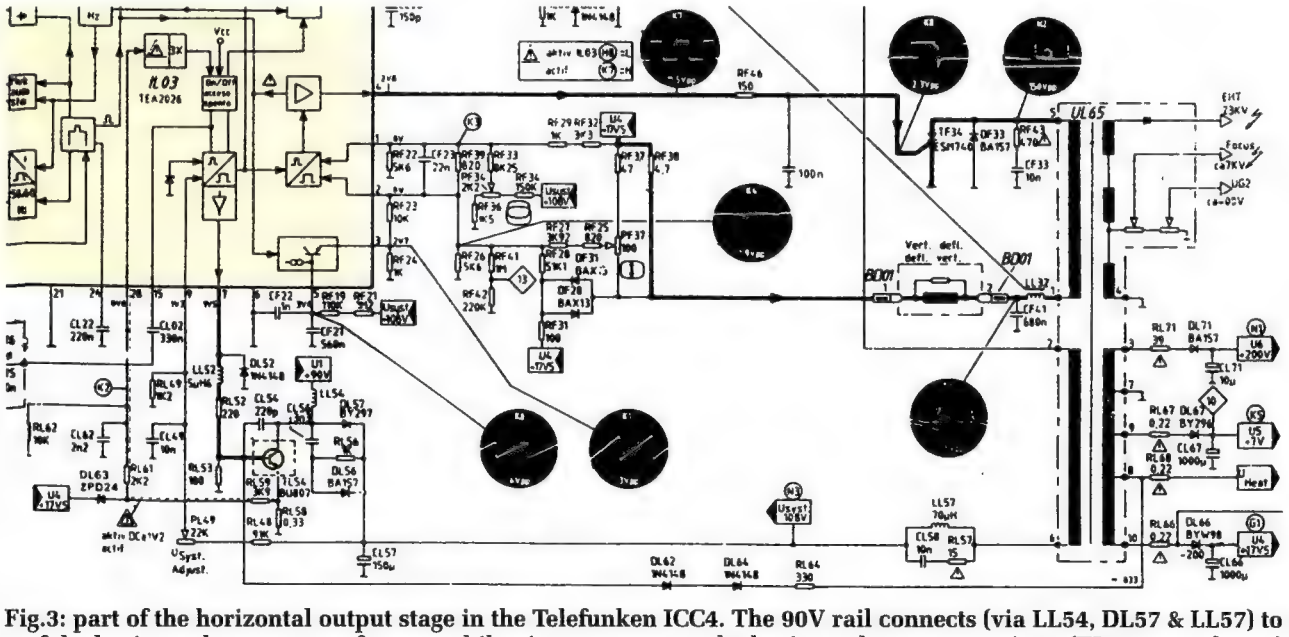


Fig.3: part of the horizontal output stage in the Telefunken ICC4. The 90V rail connects (via LL54, DL57 & LL57) to pin 6 of the horizontal output transformer, while pin 2 connects to the horizontal output transistor (TL37 – not shown).

warmer now. I restored the connection at LL54, then disconnected the rail at pin 6 of the transformer – same result.

So the fault was either somewhere on the other side of this transformer winding, in a circuit connected to one of the other windings, or in the winding itself. I restored the pin 6 connection and lifted the pin 2 connection. And it was a different story this time. I was now back to the original fault, with no voltage on any of the rails.

By now, I was becoming more and more suspicious of the transformer itself – so much so that I went for broke and pulled it out. My idea was to check it for shorted turns, which I felt was the most likely explanation.

But first I made a routine check of each winding with an ohmmeter. Well, they were all intact individually but when I happened to check between winding 2-6 and winding 1-5, I struck oil; there was a dead short between them.

Naturally, there was only one answer to a fault like that; I needed a new transformer. But that had me worried initially because I knew of no current Australian agency for Telefunken. Fortunately, a few enquiries revealed that Hitachi use the same transformer, a type 243445. In fact, as I understand it, they actually make it and Telefunken buys it from them. Anyway, they are readily available, and one was obtained and fitted.

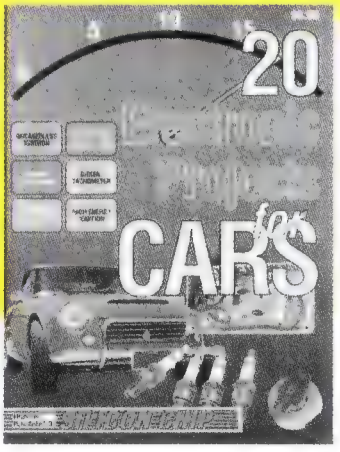
End of story? Not quite. Oh, the switchmode supply leapt into life alright at switch-on but there was one little snag – the set was still dead.

A quick check with the voltmeter provided the first clue; all the rails were up and spot on, at least out of the power supply. But there was no 12V rail out of pin 3 of regulator IP61. The reason wasn't hard to track down.

As mentioned earlier, IP61 is controlled by pin 7 of the remote control IC, IR25. This control signal is fed to pin 2 of IP61 via transistor TR74 (BC547B). And TR74 was shot – it was as simple as that.

A replacement BC547B was fitted and I finally had everything running at full bore. And a very nice result it was too. I gave the set the usual routine adjustment check, let it run for a day or so, and then passed it back to my colleague to return to his customer.

It wasn't going to be cheap, of course, taking into account the new transformer. But that's the way it goes and I hope he was happy. **SC**



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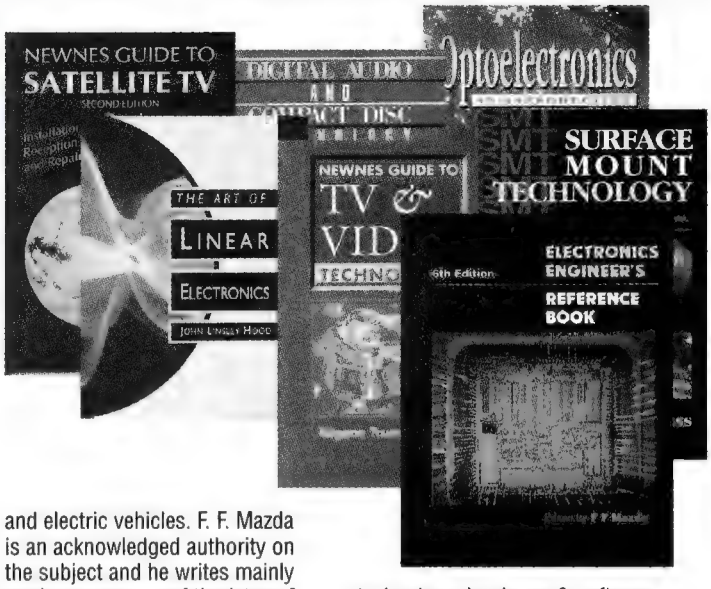

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VINTAGE RADIO

By JOHN HILL

Anode bend to diode detection

During the early to mid-1930s era, the low priced 5-valve superhet console radio was very popular. Many employed anode bend detection but they can be easily converted to diode detection for improved audio performance.

The early '30s were the tough times of the Great Depression years, when about 25% of the workforce was out of work. And, of course, they were without the back-up support that the unemployed have today. This meant that any radio manufacturer who wanted to stay in business had to produce a range of receivers that were affordable. The formula, in most cases, was to keep things fairly basic.

The usual format for these cheaper radios was the autodyne superhet – a 5-valve receiver with an autodyne mixer, IF stage, anode bend detector and a single output stage. Some designs used a 175kHz IF and this necessitated a pre-selector stage, using a 3-gang tuning capacitor, in order to control the double spot problem created by of such a low value.

Other makers chose a 455kHz IF, which was rapidly gaining popularity, and which solved the double spot problem automatically. This allowed the use of a cheaper 2-gang capacitor.

Either way, this broad design concept was a compromise between price and quality and while these sets worked reasonably well, they had several disadvantages.

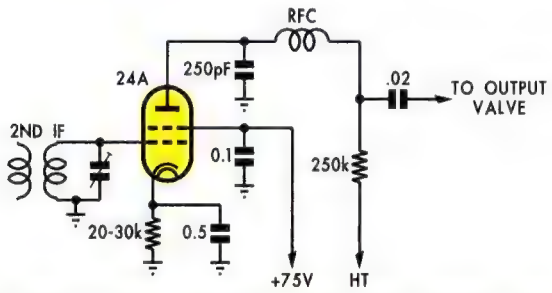


Fig.1: the circuit of a typical anode bend detector. The valve type shown is a 24A tetrode or similar sharp cutoff tetrode. Later circuits used a type 57 pentode, although the basic arrangement remained the same.

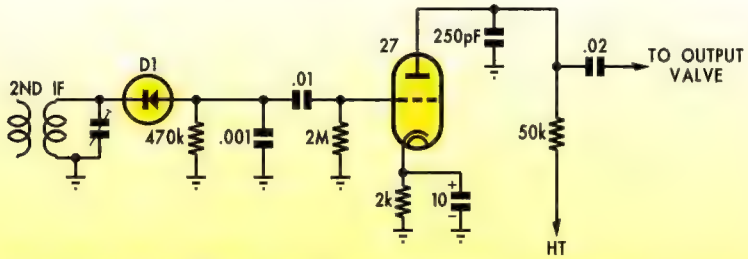


Fig.2: this is what the circuit looked like after conversion to diode detection. The original type 24A tetrode was replaced by a type 27 triode valve.

Design drawbacks

One problem was the lack of automatic gain control. This circuit innovation came into existence in the early 1930s but was only found on the more up-market receivers.

Another difficulty with the autodyne setup was that, while it worked OK on broadcast band frequencies, its performance on shortwave was not so good.

And finally, the anode bend detector used in these sets created a level of audio distortion that left something to be desired. While this distortion may have been acceptable in the 1930s, by today's standards it is not very good and can be quite distracting. It may have been fairly distracting in the 1930s too, because by the middle of that decade most manufacturers had changed to diode detection.

Some of those old receivers with anode bend detection sound better than others and in many instances the loudspeaker must play a part. The moving coil loudspeaker had been in existence for only a few years at that stage of radio development and there were still things to learn and manufacturing techniques to master. While an early '30s moving coil loudspeaker was a remarkable improvement on a '20s horn speaker, there was still quite

a lot of developmental work ahead of it.

Basic circuit

Fig.1 shows the circuit of a typical anode bend detector. The valve type shown is a 24A or similar sharp cutoff tetrode. When the type 57 valve (a pentode) was developed, it replaced the radio frequency tetrode, although the circuit arrangements for anode bend detection were still the same.

The main aspect of the anode bend detection method is the very high cathode bias resistor, which operates the valve at close to cutoff. The term "cutoff" simply means that the anode or plate current will be at or near zero when no signal is being received.

When a modulated radio frequency (RF) signal is applied to the control grid, there will be pulses of anode current during the positive half cycles and little or no anode current during the negative half cycles. Therefore, the anode current is a rectified version of the signal waveform at the grid.

Filtering of the RF component after detection is achieved by a small plate bypass capacitor (typically around 250pF) to chassis and an RF choke in series with the plate load.

Anode bend detection has some odd characteristics and the distortion it produces can be minimised by varying the value of the cathode bias resistor.

However, if the cathode bias is selected to give good low distortion sound with a strong signal at the control grid, then the performance is not as good on a weak signal and vice versa. So, after much experimenting, the cathode circuit is often returned to its original form, as the manufacturer's setup was probably a reasonable compromise.

Shown here is the Darelle 5-valve superhet cabinet. It is affectionately known as the "tea chest on legs". The Darelle's chassis was converted from anode bend detection to diode detection and this simple modification gave a significant improvement in sound quality.

Detector conversion

I have quite a number of old autodyne/anode bend console radios and I find some of them quite irritating due to their high levels of distortion. There are times I like to listen to my radios for hours on end and if they sound crook, there is no listening pleasure at all.

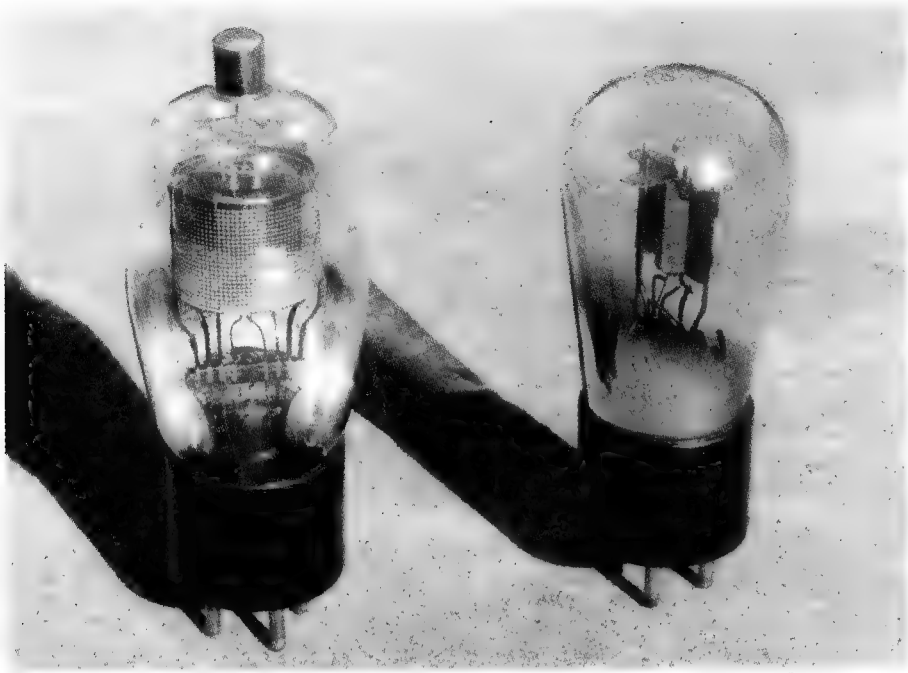
The last of these receivers to come off the restoration assembly line was an old 1932 Darelle (see June 1995). While the Darelle was no more annoying to listen to than any of the others, it was the one I selected to see if the sound reproduction could be improved by converting the set to diode detection. The experiment produced a surprisingly good result, so allow me to fill you in on the details.

There are several choices when it comes to converting a set to diode detection. One can use either a valve with diodes in it, a triode connected as a diode, or do the unforgivable and use a germanium signal diode.

As the old Darelle used tetrode valves, there was no applicable diode type valve apart from the 55 duo-diode triode. The use of this valve would require a valve socket change from 5-pin to 6-pin.

Using a triode connected as a diode was not an option either because there was insufficient room to accommodate it. So that left the unthinkable – a germanium signal diode.

Not being a modern electronics man, I was not really sure how to incorporate a solid state diode into a valve circuit. I mentioned what I planned to do to young David (a collector friend) and he drew up a circuit of what he thought I needed to make a solid state diode detector work in a valve receiver – see Fig.2. I might add that



The original anode bend detector valve was a 24A, as shown at left. This was replaced with a 27 triode (right) and this worked well as an audio amplifier, something that the 24A could not do.

David's circuit was a little more involved than what I had in mind.

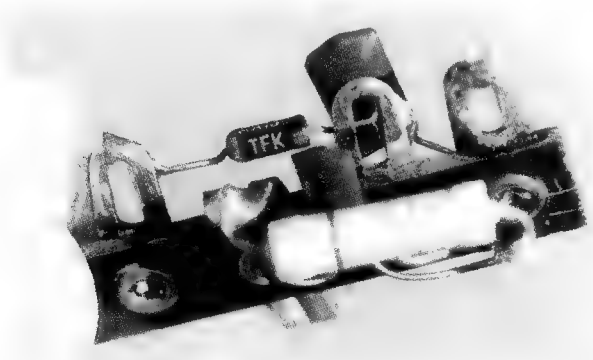
Another aspect of my conversion was to retain the existing 24A anode bend detector valve and use it as an audio amplifier – if that was at all possible. David was not confident that this could be done but as I wanted to keep the original valve line-up, I would try to do it anyway. Whether or not it would be successful was in doubt at that stage.

Many radio frequency valves (the 57 and the 6J7 for example) can be used as audio valves when connected as either pentodes or triodes. Hopefully, the 24A would perform likewise, although there is no mention of audio frequency application in the valve manual. (Editorial comment: the 24A, being a tetrode – as distinct from the above mentioned pentodes – is less suitable for use as a resistance/capacitor coupled audio amplifier. When it was used as an audio amplifier, it was usually in the choke/capacitor coupling mode. This permits a much greater plate voltage signal swing without distortion).

The detector circuit was made up on a small piece of tagstrip to form a compact detector module (see photo). This module was then bolted to a convenient part of the chassis and wired to the second IF transformer and the control grid of what was the anode bend detector. But while the set worked, one could not say that it was working well.

Actually, the sound quality was really good at moderate volume levels, but distorted badly as the volume increased.

Various alterations were made to the 24A audio amplifier. It was tried as a tetrode, a triode, with high and low plate voltages, and with a variety of cathode bias setups. None proved to be really satisfactory, although the triode connection wasn't too bad except for a drop in overall volume. It had to be considered unsatisfactory for that reason alone.



The diode detector module was built from miscellaneous components mounted on a tagstrip. The small size of the module allows it to be mounted in some out-of-sight location if so desired.

Valve replacement

It was time to do what should have been done in the first place and that is fit a valve that was more suitable for audio frequency work than a 24A. A 27 was a logical choice as its 5-pin base was compatible with the existing valve socket. Rewiring the socket to suit the triode valve required a couple of alterations, as the 27 has no top-cap grid connection.

After fitting the 27, all the previous problems associated with the diode detection modification suddenly disappeared. Triode audio amplifiers were all the go in the early 1930s and a triode also proved to be most successful with this particular circuit arrangement.

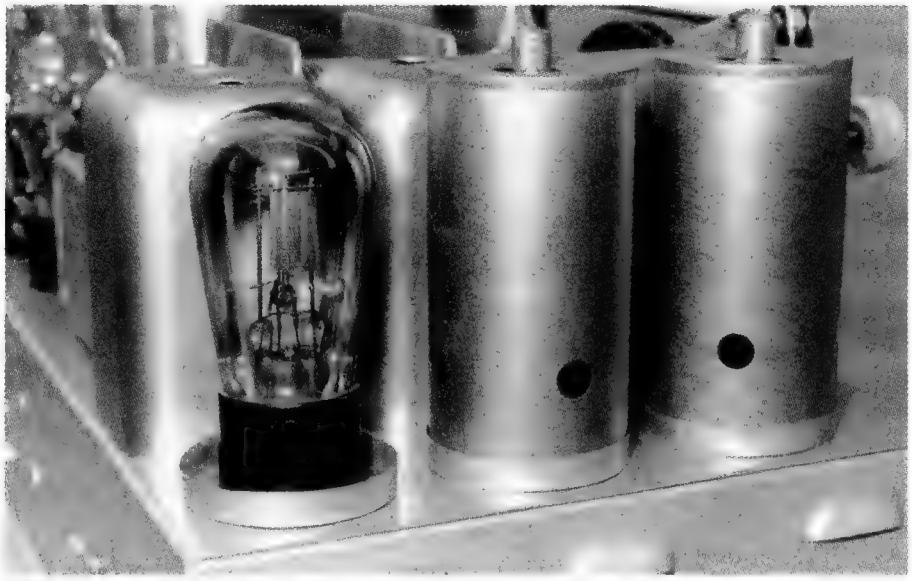
Once everything was working OK, it was time to experiment a little. The detection module was disconnected and another signal diode substituted. This setup used no grid leak, no coupling capacitor or anything else – just the diode between the IF transformer and the grid of the valve. It made little difference apart from an ever so slight increase in volume.

So it would appear as though there are many ways to incorporate a signal diode into a valve circuit – and they will all probably work. However, if one decides to do this modification, remember that the second IF transformer will require realignment. That would be about the only inconvenience incurred.

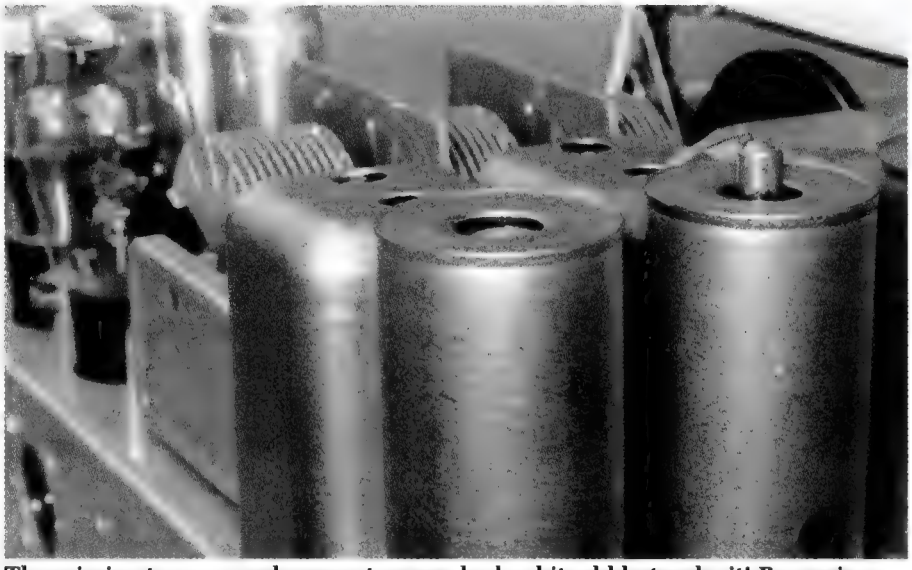
After this little experiment, the original detector module was reconnected into the circuit.

Practicality vs originality

No doubt some readers will have difficulty in understanding why I would want to modify an existing circuit and ruin the set's originality! Well, in this case, I want to listen to the radio and not be annoyed by it. It is as simple as that! What's more, if a receiver can be significantly improved by implementing such a simple modification, then why not do it? In this



Efforts to use the original 24A valve failed miserably. Substituting the 27 involved some socket rewiring and the removal of the top-cap connector. It was worth the effort, as it solved the problem of trying to use the 24A in a role for which it was never intended.



The missing top-cap and connector may look a bit odd but so be it! Removing the anode bend detector and replacing it with diode detection was an experiment that paid off with a cleaner audio output.

instance, the improvement was well worth the effort.

Should a future owner wish to convert the receiver back to original, it can easily be returned to its anode bend state. Why someone would want to do this I don't know, but if they did, they may not be happy with the distortion that this detection method produces.

The diode detector described here can be a completely invisible modification if so desired. Although I chose to mount the diode and accompanying components on a small tag strip underneath the chassis, there is no reason why it cannot be housed inside the second IF transformer shield can or positioned in some other out-of-the-way place where it is out of sight.

As far as I'm concerned, if everything looks OK then that's all that matters. A few devious modifications here and there don't upset me in the least, especially if they improve the set's performance. The fact that the old Darelle sounds a bit better than most radios from that era must be worth something! SC

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January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier; The Latest Trends In Car Sound; Pt.1.

February 1995: 50-Watt/Channel Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; The Latest Trends In Car Sound; Pt.2; Remote Control System For Models, Pt.2.

March 1995: 50W/Channel Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3; Simple CW Filter.

April 1995: Build An FM Radio Trainer, Pt.1; Photographic Timer For Darkrooms; Balanced Microphone Preamplifier & Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 8-Channel Decoder For Radio Remote Control.

May 1995: Introduction To Satellite TV; CMOS Memory Settings – What To Do When the Battery On Your Motherboard Goes Flat; Mains Music Transmitter & Receiver; Guitar Headphone Amplifier For Practice Sessions; Build An FM Radio Trainer, Pt.2; Low Cost Transistor & Mosfet Tester For DMMs; 16-Channel Decoder For Radio Remote Control.

June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; A 1W Audio Amplifier Trainer; Low-Cost Video Security System; A Multi-Channel Radio Control Transmitter For Models, Pt.1; Build A $30 Digital Multimeter.

July 1995: Low-Power Electric Fence Controller; How To Run Two Trains On A Single Track (Plus Level Crossing Lights & Sound Effects); Setting Up A Satellite TV Ground Station; Build A Door Minder; Adding RAM To A Computer.

August 1995: Vifa JV-60 2-Way Bass Reflex Loudspeaker System; A Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; The Audio Lab PC Controlled Test Instrument, Pt.1; The Mighty-Mite Powered Loudspeaker; An Easy Way To Identify IDE Hard Disc Drive Parameters.

September 1995: A Keypad Combination Lock; The Incredible Vader Voice; Railpower Mk.2 Walk-Around Throttle For Model Railways, Pt.1; Build A Jacob's Ladder Display; The Audio Lab PC Controlled Test Instrument, Pt.2; Automotive Ignition Timing, Pt.1.

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December 1995: Engine Immobiliser For Cars; Five Band Equaliser For Musicians; CB Transverter For The 80M Amateur Band, Pt.2; Build A Subwoofer Controller; Dolby Pro Logic Surround Sound Decoder Mk.2, Pt.2; Knock Sensing In Cars; RAM Doubler Reviewed; Index To Volume 8.

PLEASE NOTE: November 1987 to August 1988, October 1988 to March 1989, June 1989, August 1989, May 1990, February 1992, November 1992 and December 1992 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tearsheets) at $7.00 per article (includes. p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge.

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Sins of omission in a preamplifier

I recently constructed the Low Noise Universal Preamplifier as described in April 1994, for use with a pair of unbalanced binaural microphones. During construction, I decided to omit all components between the input pins and the op amp, as these seemed to relate largely to the phono preamp version. Any comments? It seems to work perfectly well. Would the omitted part of the circuit have made any difference or improvement?

As part of the same project, I intend to build balanced outputs. The December 1989 issue of SILICON CHIP gives a design utilising a pair of LM833s per channel to provide balanced ins and outs. Is the PC board for this available anywhere? I also came across a design in "ETI" in the December 1982 issue for a Balanced Input Differential Preamp. This used a pair of 5534 op amps, one for each of the balanced line conductors, feeding a TL071. Any comments on the pros and cons of the two different approaches to producing balanced inputs? (D. M., Canton Beach, NSW).

• Omitting all the components between the input pins and the op amp is not good practice, even though, as you have observed, the circuit will still work. The RF suppression components, consisting of the inductor L1, 150Ω resistor and the 100pF capacitors, are desirable in order to prevent pickup of interference, particularly AM radio stations. Second, the 100kΩ resistor on the op amp side of the 47µF capacitor should be retained so that, if the microphone is unplugged, the op amp continues to be correctly biased; otherwise there will be a loud 'pop' whenever the microphone is plugged in or out.

The 47µF capacitor is desirable to prevent the bias current of the LM833, typically around 0.5µA, from flowing through the microphone. This could lead to non-linearity or possibly demagnetisation, over a long period. Finally, the second 100kΩ resistor is required to make sure that the 47µF capacitor is always charged and does not charge via the microphone when it is plugged in; if this happened, a loud 'pop' would result.

The PC board for the balanced output circuit is available from RCS Radio Pty Ltd, 651 Forest Road, Bexley, NSW 2207. Phone (02) 587 3491.

The ETI circuit for balanced inputs would certainly work but a superior circuit using the special purpose SSM2017 was published in the April 1995 issue of SILICON CHIP. A kit for this project is available from Altronics, in Perth.

Speed controller for a 2hp router

Have you produced a speed control for a 2hp router. I am using it with some large diameter bits and the recommendation is to reduce the speed for safety. I know you produced a 5A speed controller but I obviously need something bigger.

By the way, the current rating for the router is 10A. Could I upgrade your 5A design by just using a bigger Triac? (N. M., Seymour, Vic).

• The 5A speed controller is the highest rating we have produced and it already uses a 40A Triac. As it stands, you could use the 5A design for your 2hp router provided you change the 10A fuse to a "slow-blow" type and you arrange for better heatsinking for the Triac. This would most easily be done by using a reasonable size diecast aluminium box.

Note that at the full speed setting with any half-wave speed control, the maximum speed of the router will be reduced by about 20%. So a 20,000 RPM router would immediately be reduced to a maximum of 16,000 RPM.

Altering timer for burglar alarm

I have just completed wiring up your Multi-Sector Home Burglar Alarm from the June 1990 edition and thankfully (for me) it worked straight away. My question is what do I alter to get a five minute alarm instead of the 10-minute period? And just as a query, why did you put the sector switches with the off position down? Thanking you for a really good magazine for novices as well as the brighter boys! (H. M., Ballina, NSW).

• The 10-minute timer comprises IC4, IC6 & IC7. Halving the 10-minute period is simply a matter of using the Q5 output (pin 5) of IC6 to drive IC7. So disconnect pin 6 of IC6 and connect pin 5 instead.

We're not sure what you mean by your question about the sector switches being down in the Off position. The design was presented in the form of PC boards so the way in which it was built was up to the constructor.

Combination AM/FM radio trainer wanted

Could the AM Radio Trainer (June/July 1993) and the FM Radio Trainer (April/May 1995) be combined to make an AM/FM Radio Trainer? Over the years I have built AM valve radio sets and AM transistor sets. I did not make the FM Radio Trainer because it only had the one section.

Completely designing a radio trainer would be desirable so that a person could obtain experience aligning the AM/FM coils using a cheap oscilloscope, sweep generator or FM-AM generator. It would be a good idea if a sweep generator kit was developed for alignment of the FM section.

By this method, one would learn

Coolant alarm for plastic radiators

I refer to the very successful coolant alarm project from the June 1994 issue. I have just purchased a new Mitsubishi Magna sedan and to my surprise, I find that the radiator appears to be of composite manufacture, with plastic head and bottom tanks moulded on to a metal heat exchanger.

The metal heat exchanger is earthed to the car body, according to my ohmmeter, and as the plastic header tank is an insulator, it would appear that a suitable sensor probe could be made by just drilling and tapping a 1/8-inch brass metal thread into the header tank. However, I would like your comments please. (B. P., Port Macquarie, NSW).

• A large number of modern cars now use radiators with plastic header tanks. While a bolt attachment to the top tank would be a simple addition, we're not keen on the idea of drilling and tapping the tank to fit a brass screw. A screw might work its way out after a time and then you really would have a loss of coolant. Nor are we keen on the idea of fitting a brass screw in close proximity to the aluminium radiator core. That seems like asking for corrosion problems.

We think it would be preferable to fit a stainless steel bolt and nut to this type of radiator, together with flat washers and a lockwasher. Naturally, this would need to be installed close to the radiator cap, in order to attach the nut and washers to the bolt.

more alignment procedures experimentally. If possible, rather than IC1-IC4 of the FM side being integrated circuits they should be completely transistorised. Then one could learn the internal structure of each circuit on the FM side. (L. F., North Bondi, NSW).

• Although FM/AM radios and tuners are standard commercial products, frequently using only one or two ICs, there is no easy way of combining our radio trainer circuits onto one PC board. These discrete circuits are quite difficult to produce on a freestanding PC board and our final versions were only arrived at after quite a few prototypes had been built.

Car burglar alarm malfunction

I'm hoping you can help with a number of problems I'm having with the Car Burglar Alarm featured in December 1994. I've obviously botched something somewhere and anything you can suggest to get the alarm working properly would be appreciated.

After assembling the kit carefully and doing a neat soldering job, I installed it in the car and no matter what I do to the trimpots it doesn't seem to work properly at all. The car it is fitted in is a Volkswagen Beetle, not a very complicated car in terms of wiring, so installation was easy, even for an amateur like me. About the only extra items fitted to the kit are two pin switches under the bonnet and boot which are connected to the "Immediate Sense" circuit of the alarm and a key switch as opposed to the toggle switch included in the kit.

When I arm the alarm with the key switch the LED doesn't "continuously light" as described in the assembly instructions. But after the set exit delay period, the LED starts flashing to indicate the alarm is set. When I then open a door or the bonnet or boot to set off the alarm/horn siren, the LED continues to flash instead of turning itself off to indicate it is going to sound the horn siren. However, the horn siren fails to go off at all. The LED continues to flash and switching the keyswitch to "disarm", fails to have any effect on the LED (and obviously the alarm as well) and the only way to turn it off is to push in the door pin switch of the open door. So it appears I can arm the alarm (sort of) but not disarm it. (J. C., Melbourne, Vic).

• As far as we can tell from your description, IC2 and the LED are operating normally. The LED does not start to flash until after the exit period. We suggest that you carefully check the voltages around the circuit

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Door minder is insensitive

I have recently assembled the "Door Minder" kit as published in the July 1995 issue of SILICON CHIP. I find that it is not very sensitive and it only works in a small room with the windows shut and if I give the door a hefty pull. I would be most grateful if you could tell me how to make it more sensitive; the preset pot is adjusted to the most sensitive it will go. The article says it works with open windows in an adjoining room.

Also, where can I purchase the Philips ETD49/25/16 transformer components and the TEA100 nicad monitor IC for the Fast Nicad Charger, as published in the September 1995 issue?

I refer to the letter on page 7 of the April 1995 issue, on making PC boards by photocopying the original back to front and rubbing with thinners mixture on the back. I have had limited success and find it is best if the photocopy is removed whilst still moist. I say moist and not wet, as too much thinners gets underneath and smudges the pattern. When dry, doing it a second time darkens the picture but use a fresh, new photocopy.

However, the result produces a porous copper surface which has to be heavily layered with solder. An improvement can be made by going over the whole pattern with a fine felt tip pen which is water resistant. (D. S., Caloundra, Qld).

• We are surprised that your Door Minder is so insensitive. You should check that the 0.1µF and 1µF capacitors on IC1a's input are the correct values and that the 1µF capacitor is inserted with the correct polarity. Also confirm that the two resistors around IC1a are 47kΩ and 3.9MΩ – a wrong value may have been fitted. Also, did you ground the case of the electret insert?

Check that the regulated DC is about 8V and the voltage on pin 1 of IC1a is 3.3V. As the circuit has a gain of 80 it only needs 10mV from the microphone to trigger the chimes. It should not be necessary to increase the gain of the circuit, as it is quite adequate. Perhaps the microphone insert is faulty.

You can get some extra gain by decreasing the 47kΩ input resistor to 39kΩ but any more variation could alter the passband of the filter.

Regarding the parts for the Fast Nicad Charger, these can be purchased from Jaycar Electronics.

and also monitor the output of IC1 to see that it delivers the correct signal from its output in response to the arm/disarm switch.

How to reduce preamp gain

I recently put together the preamp section of your 50W amplifier design and find it very satisfactory. My amplifier and speakers are of very high sensitivity so I need much less gain than is provided. Would you please advise the correct way of changing the feedback components around IC1 to achieve closer to unity gain? I prefer to do this rather than use attenuators. (K. A., Moss Vale, NSW).

• The gain of IC1 can be reduced by increasing the 4.7kΩ resistor at pins 6 & 2. To halve the gain, increase the 4.7kΩ resistor to 10kΩ. To obtain unity gain, omit the 4.7kΩ resistor.

Frigid remote control won't respond

I have just built the UHF remote switch from the December 1989 issue of SILICON CHIP. It is operating perfectly from a distance of 10 metres but only when the temperature is over 20°C. Can you advise how to overcome this problem as the temperature in Victoria is generally under 20°C. (P. L., Springvale North, Vic).

• Ever thought of moving to warmer climes? It appears as though one or more of the transistors or possibly one of the ICs is temperature sensitive. As a first step, we suggest you check all voltages in the circuit. Second, check all soldering on the PC boards. Cold solder joints can be temperature sensitive. Third, with a can of freezer spray, freeze each semiconductor component to see if it causes the problem. Alternatively, replace the transistors one by one to see if you can effect a cure.

Extended leads for a digital thermometer

Recently, I bought a digital thermometer with indoor/outdoor display from Jaycar (Cat QM-7210). I intended to extend the outdoor twin lead by a further 12 metres to enable the probe to be sited in the foliage of a bushy tree for a genuine outdoor reading. Doing this increased the leads' total resistance by about 0.3Ω which, in turn, increased the readout figure by 7°C. I tried counteracting this by adding 0.3Ω in parallel with the probe but then the readout for this probe disappears.

I cannot see any internal adjustment to compensate for extra lead length. Have any readers had similar experience along these lines? (M. B., Taree, NSW).

• We doubt whether the additional resistance in the probe leads has caused the increase in temperature reading. We are more inclined to think that the long leads may be picking up hash which is adding to the reading. Try connecting a 0.1µF greencap or MKT capacitor across the probe leads where they enter the case.

Note & Errata

Dolby Pro Logic Surround Sound Decoder, Pt.1, November 1995: the anode of diode D12 is shown incorrectly joined to the junction of the cathode of D14 and an associated 10kΩ resistor. Instead, D14 and the 10kΩ resistor should connect directly to pushbutton switch S7.

Dolby Pro Logic Surround Sound Decoder, Pt.2, December 1995: the resistor connected to pin 21 of IC2 is marked "30O" on the layout diagram (Fig.4, p71). The correct value of this resistor is 30Ω.

Five-Band Equaliser, December 1995: the supply pins for IC2 on the circuit diagram (Fig.5, p24) are shown reversed. Pin 4 should go to the +15V rail, while pin 11 should go to -15V. The parts layout diagram (Fig.6, p25) is correct. **SC**

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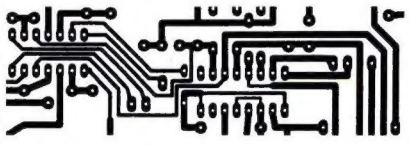

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Jaycar 45-52
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L & M Satellite Supplies 3
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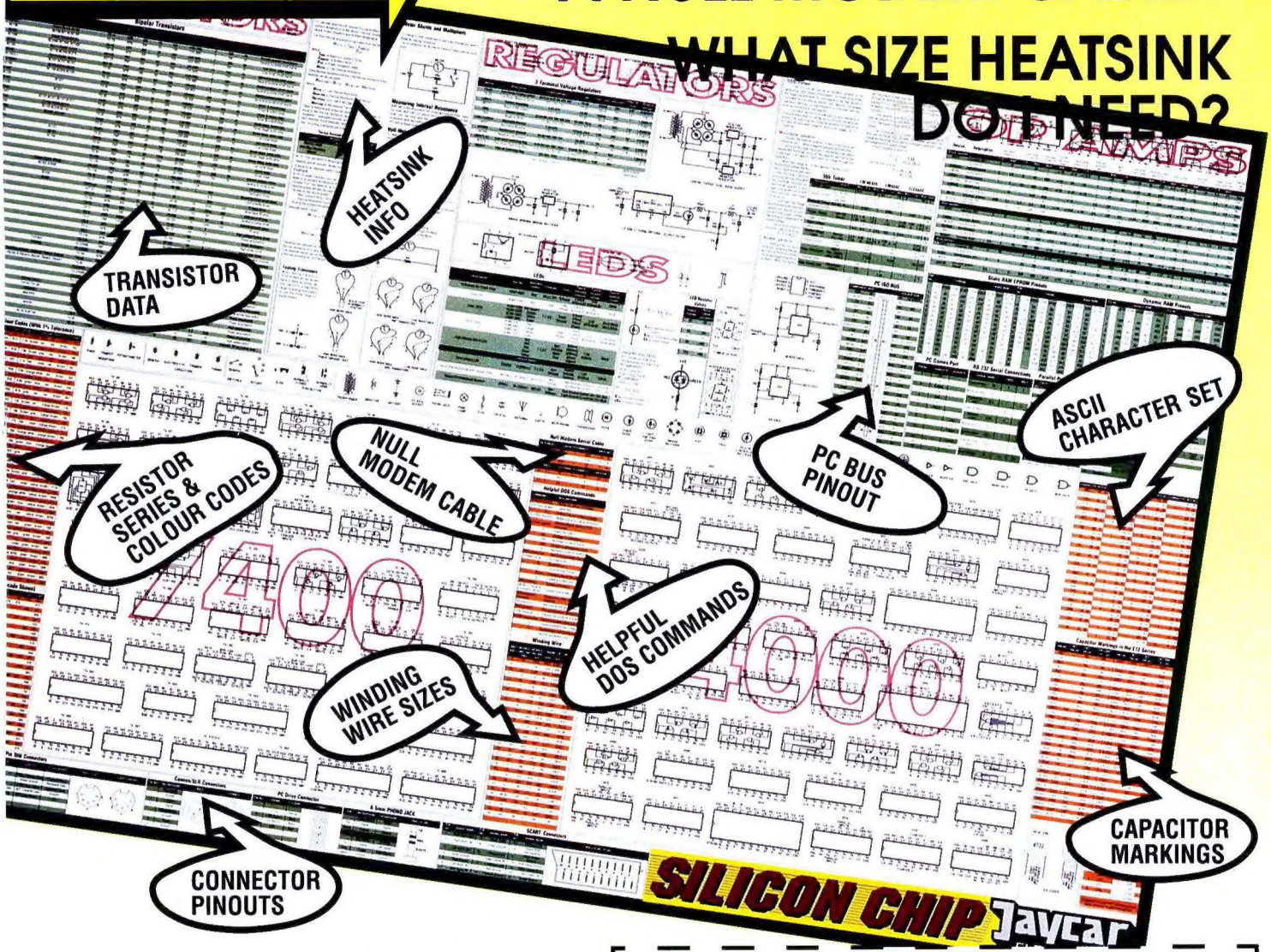

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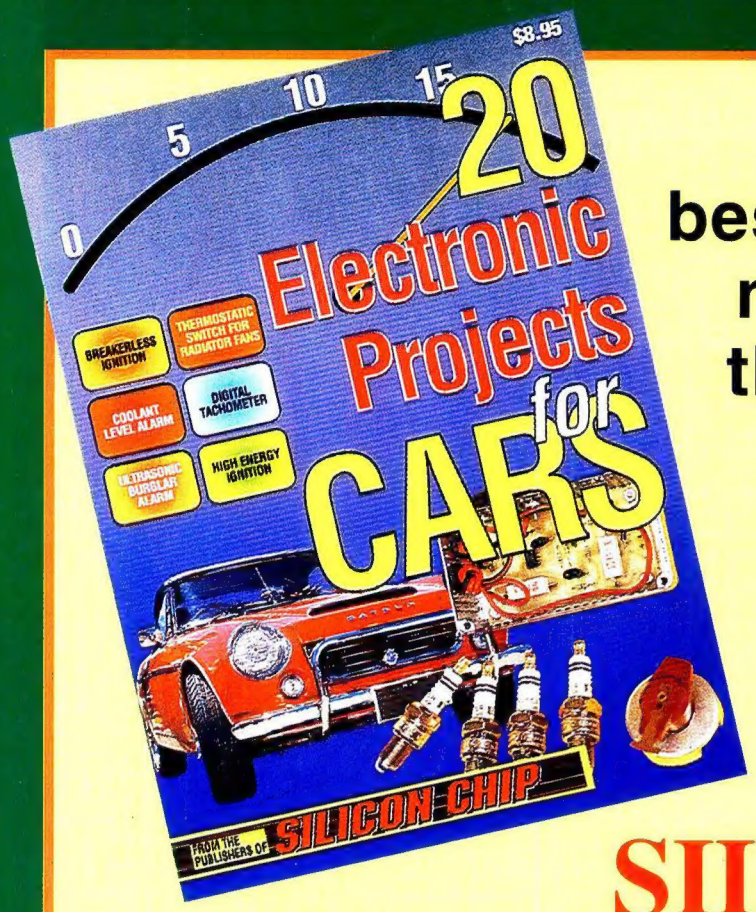

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